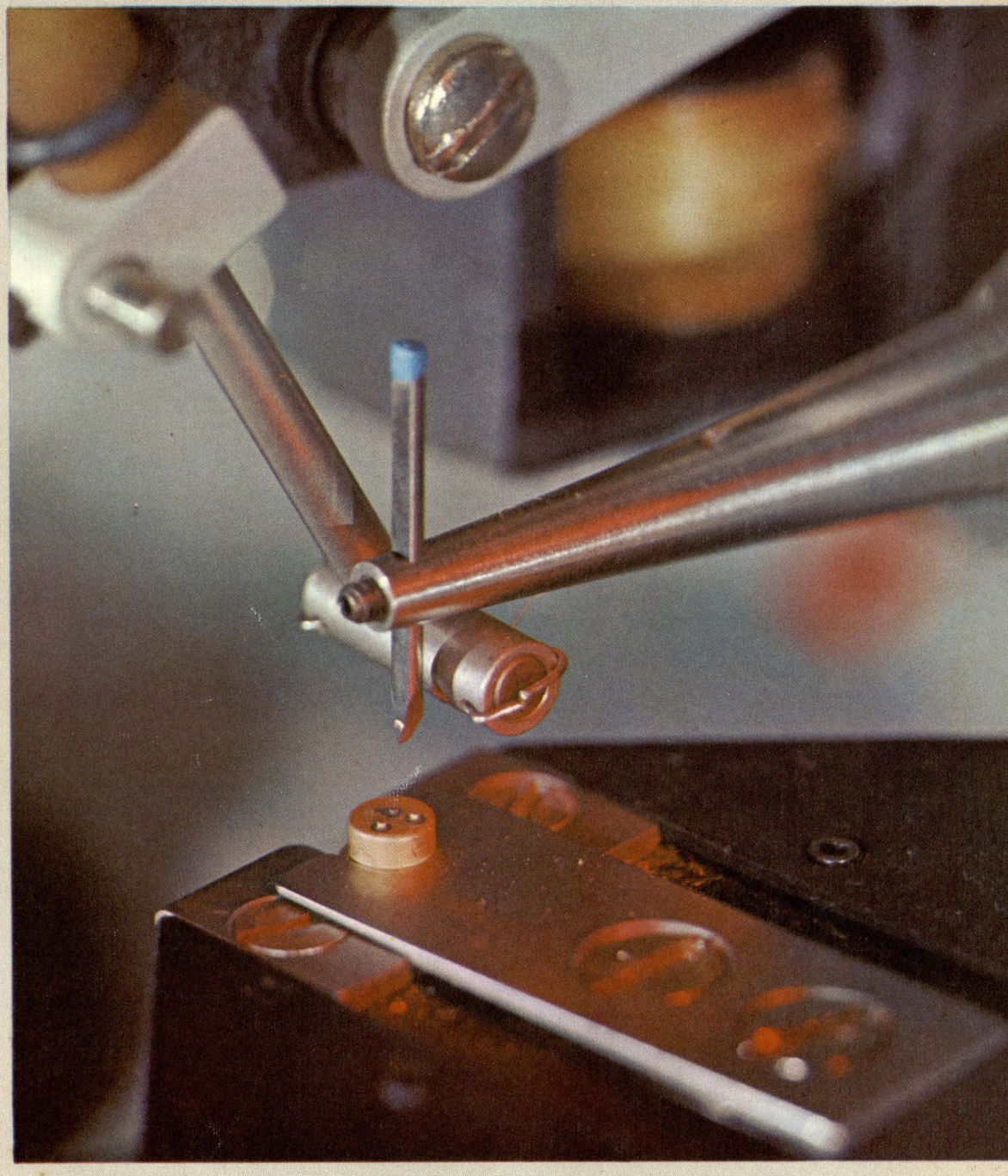
ELECTRONICS Australia

July, 1967

Incorporating RADIO, TELEVISION & HOBBIES Vol. 29 No. 4



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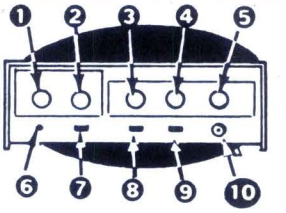

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Technical Queries

Quite early in the history of what is now "Electronics Australia" we made provision for a postal query service, mainly with the object of assisting readers who might encounter difficulties with one of our projects. From this small beginning a situation has gradually developed where, faced with an electronic problem, any one of a hundred thousand or more readers are likely to drop twenty cents into an envelope with a request that "Electronics Australia" sort it out for them!

We've struggled for years to cope with the correspondence, trying to give whatever help we could. We've streamlined our procedures to the limit, in an effort to reduce inroads on staff time . . . but to little avail. We have reached the intolerable situation where the handling of postal queries is seriously prejudicing our very ability to produce the magazine itself. We have simply had to draw a firm line, as set out in the panel on page 155. In future:

- We will supply back numbers, tearsheets, reprints, photographs, etc., for the amounts as set out. Where a need can be stated only in general terms, we will do our best to select something from our files which may be helpful.
- As a mark of good faith, we will maintain a postal reply service in relation to articles and projects in the magazine for a period of twelve months after publication.
- We must politely but firmly refuse to answer through the post, questions relating to older projects, to special designs or modifications, or to commercial equipment.
- Questions not eligible for answer by post may be submitted for possible answer through the columns of the magazine. Each month, we will select those which appear to be typical and interesting and publish both question and comment in our "Answers to Correspondents" section.

It is not a pleasant task having to impose limitations on a service which I, personally, have sought to maintain for over twenty-five years. It would be even more unpleasant if I knew that we were offering less than other comparable journals. In fact, this is not the case and, even in its amended form, our reader service compares more than favourably with any other electronics magazine that I know of, from anywhere in the world.

N. Williams

July, 1967

COVER PICTURE: Taken at the Fairchild factory in Croydon, Victoria, the picture shows a vital step in the production of silicon Planar transistors. The tiny dice — the actual transistor — now attached to the "header" assembly, is connected by ultra-fine wires to the external connecting leads. (See article on page 8.)

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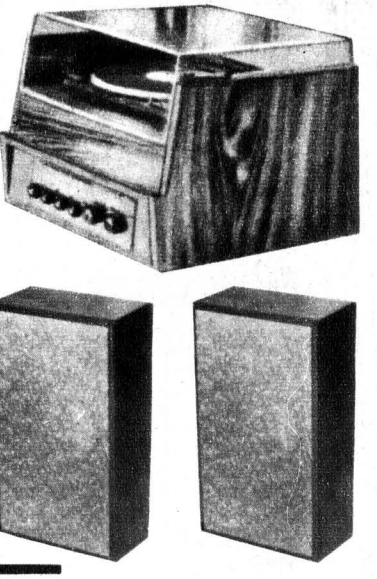

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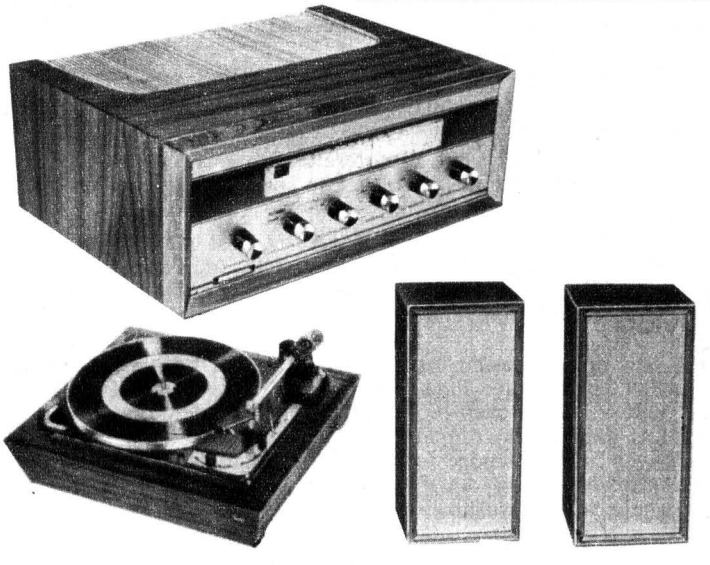

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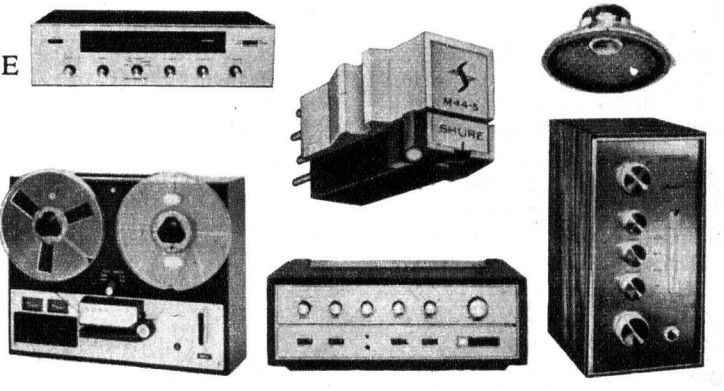

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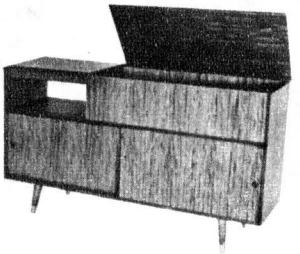

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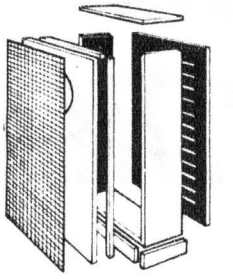

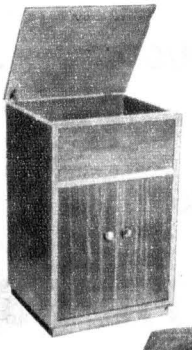

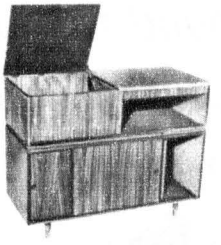

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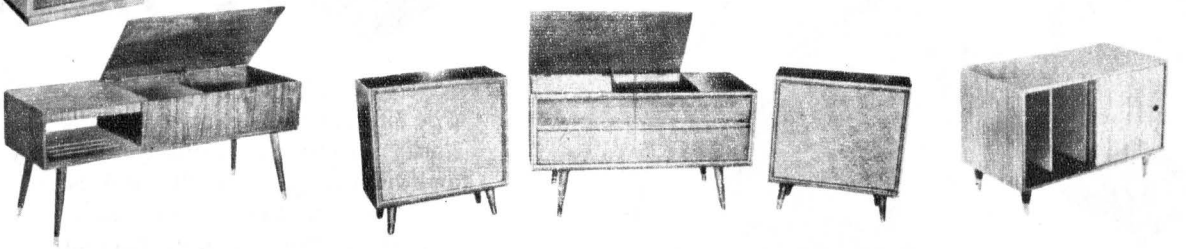

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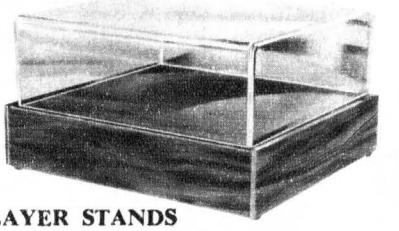

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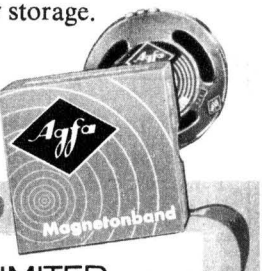

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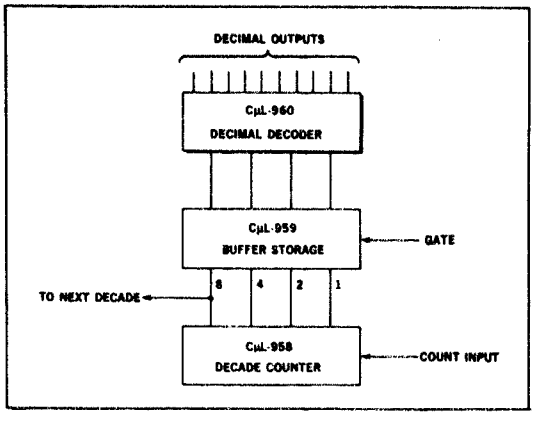
To help you, there is a diagram below to illustrate the basic functions. Plus circuit diagrams and some relevant details.

For fuller information, write for free data sheets and applications bulletins by completing and mailing the enclosed card. Joe's wife will be pleased you're taking an interest.



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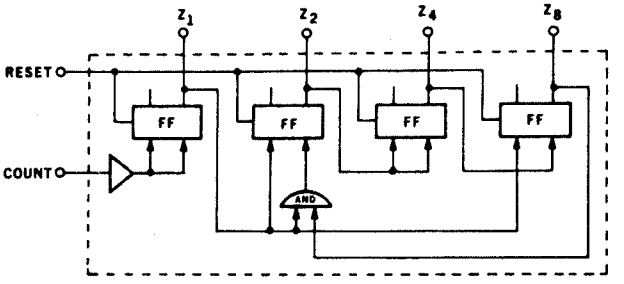
CμL 9958 DECADE COUNTER

Four flip-flops, a count input amplifier and a reset input are interconnected internally, so 9958 counts from 0 to 9 inclusive in 1-2-4-8 binary coded decimals (BCD). Four outputs are labelled Z_1, Z_2, Z_4 and Z_8. A high level pulse resets the circuit to count 0. It remains at this state until low level voltage starts it counting. 9958 can be preset to any arbitrary number by pulling down the appropriate 2_1; 2_2; 2_3; 2_4 pins. Maximum input is 2MC guaranteed, 4MC typical. Count inputs are to 2.0 MHz. V_{cc} range is 3.3V to 5.5V. Operating temperatures range from 0-75°C. Packages are 14 pin Dual-In-Line. Loading rules are given in our free 9958 data sheets. The 9960 data sheet and APP118/2 show applications typical of counters, DVM's and test equipment. Another use is as a 10:1 frequency divider.



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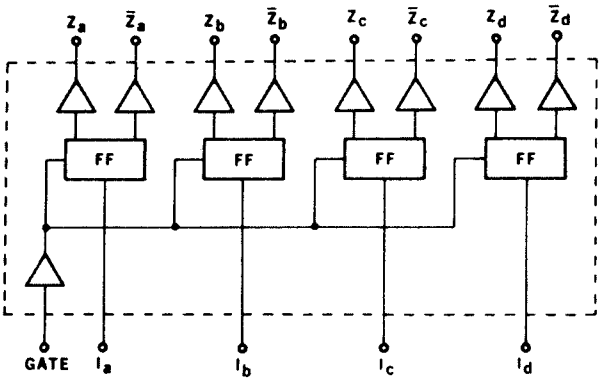
CμL 9959 4-BIT BUFFER-STORAGE ELEMENT

9959 is a static storage register or a memory device. Information from 9958 is sampled and held in 9959 until new information is entered. So it is a memory circuit consisting of four latch circuits and a common gate driver. When the gate input is high, no information enters and 9959 remains static. When the gate input is low, new information is entered into each latch and transferred to the output. At a greater count frequency than 10 CPS, the 9959 must be used to display the sampled count. It is not required at lower than 10 CPS, or when only the final count need be displayed. Operating temperatures are 0 to 75°C, extendable to 55 to 125°C. V_{cc} range is 3.3V to 5.5V. Package is 16 pin Dual-In-Line. 9959 can also be used in conjunction with RTμL elements. Loading rules are given on the 9959 data sheet — free from Fairchild.



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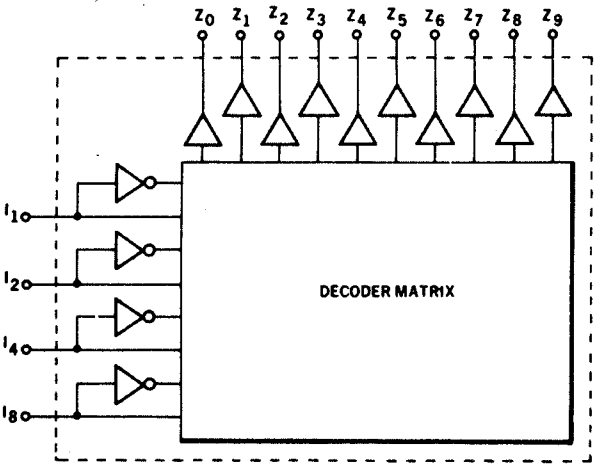
CμL 9960 DECODER DISPLAY DRIVER

Compatible with 9958 and 9959, 9960 is a monolithic device which decodes BCD into decimal numbers and drives the appropriate cathodes of a gas filled read-out tube (or Nixie). It accepts only 4-line 1-2-4-8 BCD information from binary 0 to binary 9 inclusive. Higher Count (10-15) input causes two outputs to turn on simultaneously. 9960 works at specific voltages, with logic levels also supplied by RTμL devices. To withstand the high voltages of the read-out tube, the 9960 breakdown voltage is 55V min and typically 75V. The 'on' output can pass up 10mA, adequate for even a 'Jumbo' size tube. 9960 is not recommended for use by itself as a decoder. Operating temperatures range from 0-75°C, extendable to −55°C. V_{cc} range is 3.3V to 5.5V. Package is 16 pin Dual-In-Line. Loading rules are given on the free 9960 data sheet.



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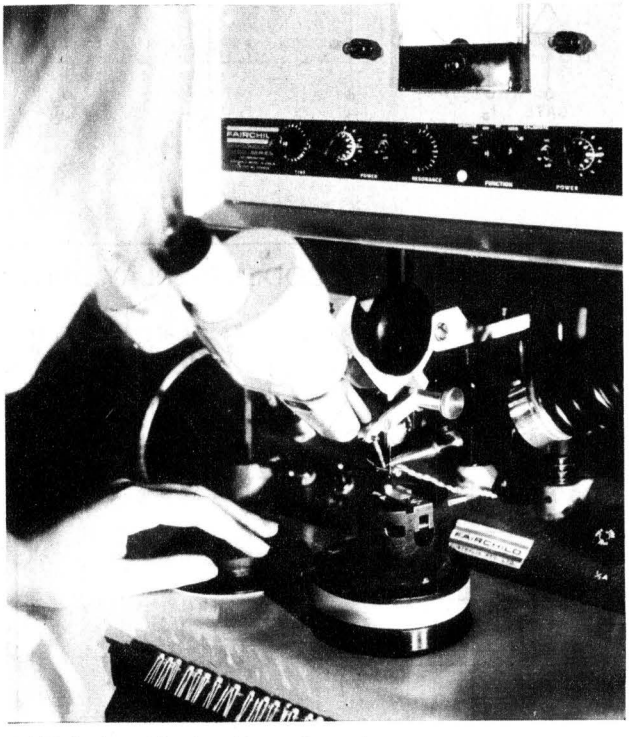
SILICON PLANAR

Fabrication of transistors using the Planar (T.M.) process involves two basic concepts: (1) gaseous diffusion of impurity atoms into the host semiconductor wafer, and (2) the use of a silicon dioxide layer on the surface of the wafer, which by its virtual "capacity" to the impurity atoms functions both as a protective sheath for the wafer and also —when appropriately etched away using a photolithographic technique — as a selective mask to control the diffusion.

Two types of transistors are produced using the Planar process — those in which the basic wafer prior to the diffusion processes consists of a host semiconductor substrate to which has already been epitaxially grown a suitably doped collector layer, called for convenience "epitaxial devices," and those in which the basic wafer consists only of homogenous host semiconductor. The latter are called "non-epitaxial devices."

Non-epitaxial wafers are produced from single crystal ingots grown pre-doped as either "N" or "P." The ingots grown for these wafers are lightly doped; in other words, they are of high resistivity because the breakdown behaviour of the resulting transistor is determined by this starting resistivity. Resistivity ranges are from 0.5 ohm-cM to 50 ohm-cM, depending on the device being made. The ingots are grown from molten silicon at approximately 1500 deg. C.

To maintain substantially uniform doping throughout the crystal and thus get more usable wafers for a given product, a dopant must be chosen that has very close to the same solubility in molten and crystalline silicon, so that the dopant will distribute itself evenly. "N" ingots are doped with phosphorus, while "P" ingots are doped with boron. After the ingot has been grown, it is sliced with a diamond saw into wafers approximately 14 mils. thick (.014 inches or 350 microns). Wafers from the correct resistivity range are selected, then lapped, etched and polished so that the surface is mirror-like. The wafer at this point is approximately 8 mils thick, and of a diameter such that it will ultimately be capable of division into a great many individual transistor dice.



With the aid of a binocular microscope, an operator attaches the tiny wires which connect the emitter and base of the dice to the external connecting leads. These are part of the "header" assembly, to which the dice is attached.

Epitaxial wafers are produced in a similar manner. The ingots grown are very heavily doped to obtain very low resistivity substrates. Typical resistivity for an epitaxial substrate is .005 ohm-cM. The substrate is then sawn, lapped, polished and etched to wafers approximately 5.5 mils thick. Next a high resistivity epitaxial film is grown on the top of these substrate wafers. This process takes place in an epitaxial reactor at approximately 1200°C. Depending upon device design, this film can be very thin — 4 microns (.2 mil) or relatively thick — 18 microns (.75 mil). The film is grown in such a way that the atoms continue the single crystal structure of the wafer — hence the term "epitaxial."

The reason for the epitaxial process is twofold. First, and most important, epitaxial devices have lower Vce (sat) (collector-emitter saturation voltage) and larger useful current ranges while maintaining high breakdown voltages. Secondly, because double-diffused devices contain most of the effective stored charge in the high resistivity collector regions, reduction of the physical volume of the high voltage collector region lowers storage time and thus improves switching times.

Figures 1 and 2 depict cross-sections of non-epitaxial and epitaxial wafers.

The next steps in the process involve multiple selective diffusions. In order to do these diffusions while still protecting the device, silicon dioxide (glass) is grown on the surface of each wafer. Then, using a photolithographic process, windows are cut through this oxide through which are diffused the "N" and "P" dopants. This step — oxidation prior to any diffusion — is the key to the Planar process. This process will only work if the dopants used will not diffuse through the silicon dioxide coating. Thus, the dopants must be chosen carefully. The reason that silicon Planar transistors are possible is that there are dopants which will not go through silicon dioxide.

It is possible to oxidize germanium and thus make a Planar germanium structure. However, the diffusants used go right through the germanium oxide as well as any windowcut, so that germanium oxide Planar transistors are not practicable.

The window cutting process is shown in figures 3 to 8. The steps are as follows:

(1) Wafer is oxidized — figure 3.

(2) A photosensitive material is applied to the top of the wafer. This material is called photo resist — figure 4.

(3) a light pattern is projected on to the wafer to expose certain areas, leaving unexposed areas or "windows" —figure 5.

(4) The wafer is dipped in a developer which only removes the unexposed photo-resist — figure 6.

(5) The wafer is dipped in an etchant, primarily hydrofluoric acid which attacks only the now exposed silicon dioxide. It affects neither the exposed photo-resist nor the silicon—figure 7.

(6) The wafer is then dipped into a solution (chromic acid) which washes away the remaining unexposed photo-resist leaving a window in the silicon dioxide through which dopants may pass — figure 8.

TRANSISTORS

By D. D. Myles,
Fairchild Australia Pty. Ltd.

Each time a window is cut this same process is used. Note: The wafer has silicon dioxide on both sides after each diffusion step. All the diffusions are done from one side. The back side is etched off in step 5 above.

In making Planar devices, each time a wafer comes out of a furnace the entire wafer has silicon dioxide covering all junctions. Towards the end of each diffusion step oxide is grown over the diffusion windows. Thus the junctions are protected during each step. Figures 9 to 12 show the multiple diffusion-oxidation cycle involved for a double-diffused device. Note: (1) that the multiple oxidations leave steps in the oxide. Oxide grows everwhere when it grows at all, including the reverse side of the wafer. These steps can clearly be recognised under a microscope as apparently different colours, due to the refraction of light through the different thicknesses.

The first diffusion in Fairchild's process is the base diffusion. After base diffusion, the emitter diffusion is accomplished. To provide the correct polarities, doping densities and process control, different doping agents are used for the different regions. For the base of an NPN and the emitter of a PNP boron is used as the doping agent. For the base of a PNP and the emitter of an NPN phosphorus is used.

At this point in the process most of the characteristics of the transistor will be determined. The factors which affect these characteristics are important and should be mentioned.

First, some preliminary information is necessary:

(a) The process of diffusion is a dynamic one. When a wafer is exposed to diffusion temperatures (approx. 1000 deg. C) the doping agents will all diffuse from areas of high concentration (highly doped) toward areas of low concentration (lightly doped). Hence during the emitter diffusion, for example, the base-collector junctions will tend to "travel" further into the wafer.

(b) The speed at which a dopant moves is directly related to both concentration and temperature. The higher the temperature or concentration, the faster the dopants will move.

(c) Because there is only a fixed amount of dopant on a wafer or transistor, the farther away from the surface of the device the junction goes (deeper), the lower the concentration of dopant.

(d) A region of high dopant concentration has low resistance or resistivity. Low resistivity comes from the fact that large dopant concentrations lead to large concentrations of carriers (electrons or holes).

After the base is diffused the emitter-base junction must tend to "catch up" with the collector-base junction to provide a thin base, as shown in figure 13. The characteristics of the transistor can be greatly influenced by the location within the transistor of the base region.

Figure 14 shows a finished transistor die with the important dimensions labelled:

E = depth of the emitter.

B = depth of the base.

T = thickness of the base.

"T" is not independent of either "E" or "B." Because of practical considerations it is much easier to make "T" small (thin bases) when "B" is small (shallow base). In addition one has much better control of both "B" and "E" emitter and base depth when the doping densities are relatively large. A rule of thumb for best control is that the emitter depth should be ½ base depth.

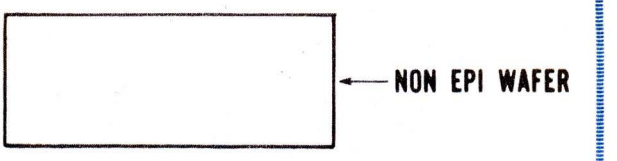


Fig. 1

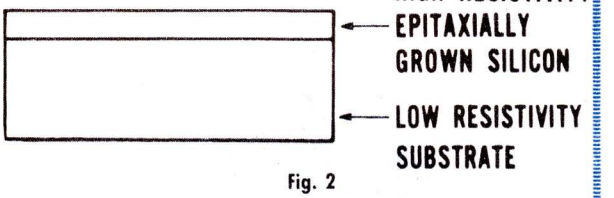


Fig. 2

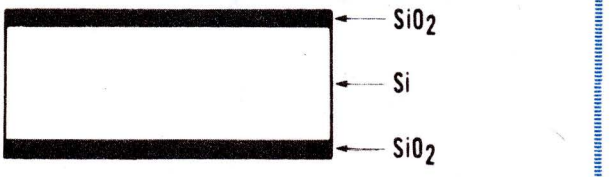


Fig. 3

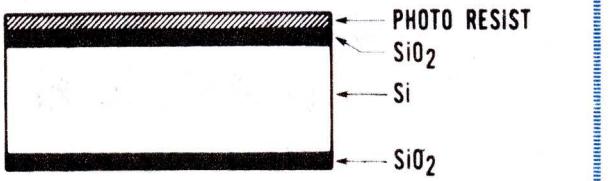


Fig. 4

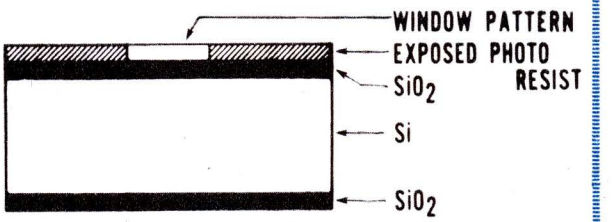


Fig. 5

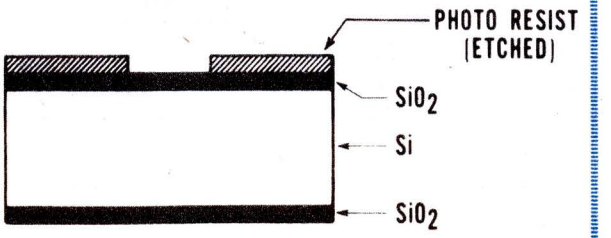


Fig. 6

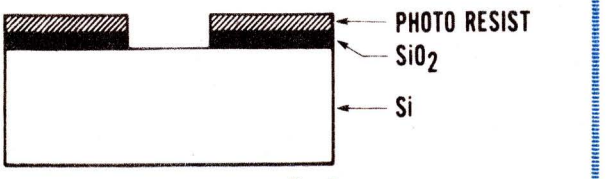


Fig. 7

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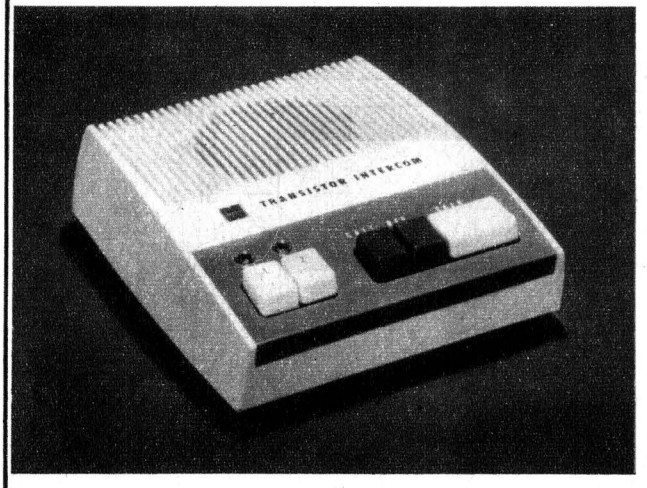

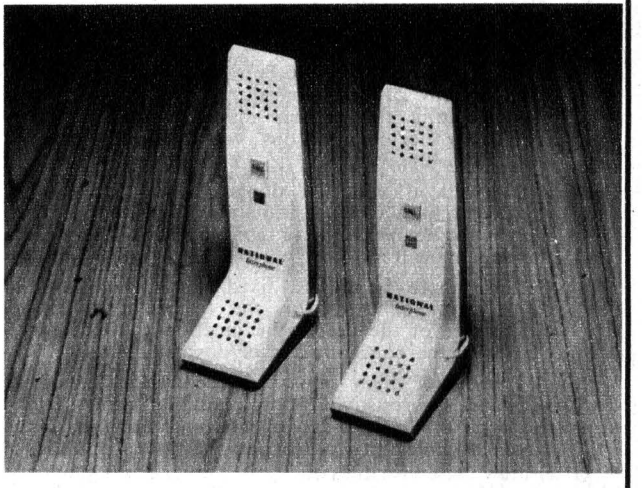

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In addition to the emitter and base diffusions other diffusion steps are needed to provide the special characteristics of today's high performance devices.

PNP transistors pose a problem due to the tendency of the surface near the oxide in the collector region to "invert"; that is, to change from "P" material to "N" material. An inversion layer of this type is called a channel. Two methods are used at Fairchild to eliminate this problem. The first involves a gallium diffusion across the whole surface of the chip. This process lowers the surface resistivity so that inversion will not occur. This process is limited to low voltage devices due to the fact that the actual breakdown voltage of the device is lowered.

The second method is used on higher voltage devices. It involves a modification of the so-called "annular ring" process, illustrated in figure 15. At the same time as the emitter is diffused, a diffusion is made outside and around the base area, extending all the way to the edge of the chip. In addition, a so-called EQR (equipotential ring) shield contact is deposited during the metalising step, extending from this low resistivity surface diffusion over the silicon dioxide above the collector-base junction. These added steps have the following results:

(a) The low resistivity surface diffusion terminates incipient inversion layers (channels). An annular ring not extending to the edge of the chip might not do this, as it could have crystalline defects which allow a channel to continue on to the other side.

(b) The EQR changes the electric field in the oxide from horizontal to predominantly vertical. A horizontal field (called a transverse field) can move ions horizontally through the transistor structure to make an incipient channel grow. The EQR minimises this effect. When the EQR is used, the gallium diffusion is not used.

Thus, with the surface diffusion terminating the channel, EQR limiting ion movement, and the PLANAR II process eliminating the ions, virtually every safeguard possible is provided to ensure a reliable device.

Devices intended for high speed saturated switching receive a further diffusion to reduce the lifetime of the carriers. Gold is diffused into the device from the reverse side of the wafer. Reducing the lifetime lowers the storage time of the transistor. Storage time can be reduced by a factor of approximately 50 times using this method. In a non-gold doped transistor the storage time is about 85 per cent of the total switching time. Gold doping thus reduces total switching times from approximately 1uS to the low nanosecond region. Some undesirable side effects are introduced but, when saturated switching is the criteria, these side effects are less important. The side effects are:

(a) Leakage (currents) are increased.

(b) Vce (sat) increases.

(c) hfe (the DC forward-emitter current gain) is reduced.

Devices requiring high hfe and low leakage must get the opposite treatment from gold doping. Material must be diffused into the device which increases the lifetime. Thus, a "gettering" is performed on these devices to raise lifetime by lowering the recombination centres. This gettering is done like gold diffusion from the reverse side. Suitable gettering agents are nickel and phosphorus.

Both the gold doping and gettering steps are performed after the last diffusion (emitter diffusion, or gallium).

Once the transistor wafer is completely diffused, metal contacts must be made to the active base and emitter regions. Figure 16 illustrates the sequence for depositing aluminium for this purpose.

Figure 16A shows a transistor with the oxide cuts for both the emitter and base metallising. The reverse-side silicon dioxide has already been etched away during the step that cuts the windows for the metallising. The wafers are placed in a bell jar which contains aluminium pellets. The jar is evacuated and the aluminium vaporised, depositing it on the complete surface of each wafer.

Figure 16B shows the device after the aluminium is deposited. Then, using similar masking and etching steps to those described above, the aluminium is removed from the surface of the wafer except in the places required for base and emitter contacts, any metal-over-oxide bonding pads, or EQR rings.

Figure 16C depicts a wafer at this step. The wafers are then put in a furnace at approximately 600°C in order to allow the aluminium into the surface. This

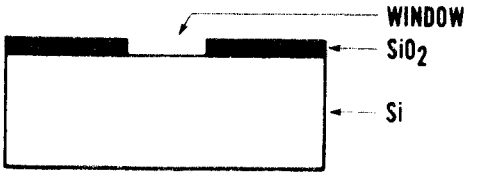

Fig. 8

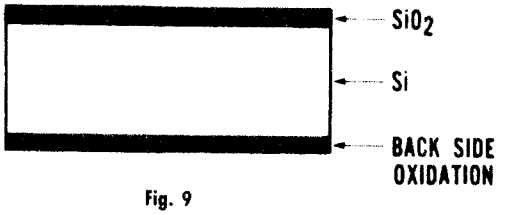

Fig. 9

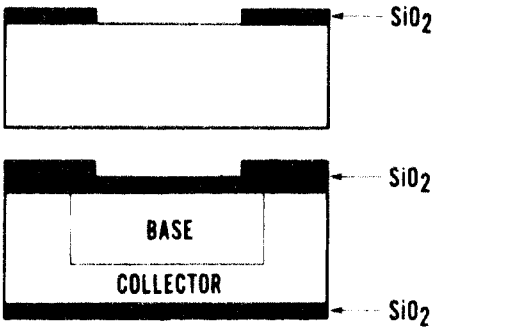

Fig. 10

Fig. 11

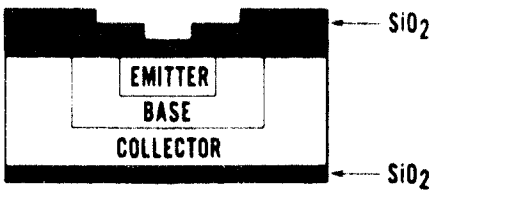

Fig. 12

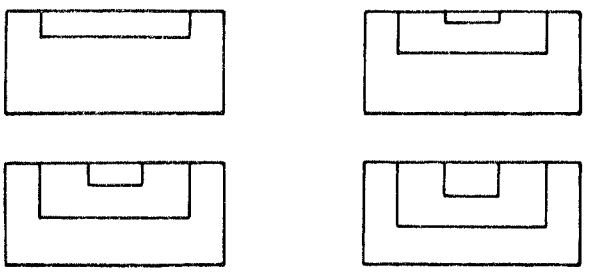

Fig. 13

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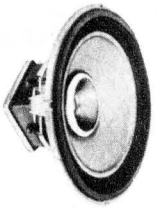
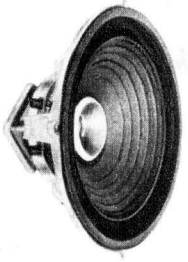
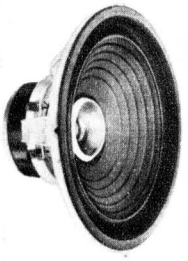


8" BRONZE/RS/DD
Very effective in a 1 cu. ft. enclosure, the response of this low priced model is 50-20,000 Hz. Impedance 10/15 ohms. Handles 10 watts peak power.



10" BRONZE/RS/DD
A low priced wide range speaker with a frequency response of 35-20,000 Hz. and ideal for use in a small enclosure. Rated at 12 watts peak power. Roll surround and double diaphragm.



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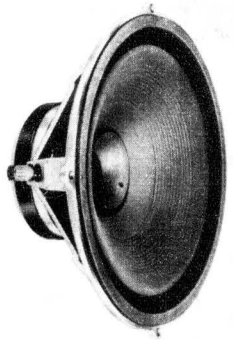
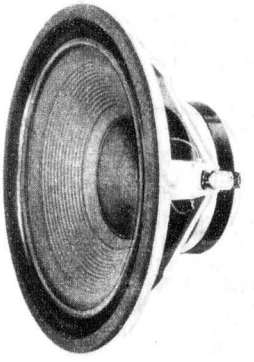
Handling 30 watts peak power, the W 12/FRS is an ideal bass reproducer for multiple speaker systems. Frequency response is 30-4,000 Hz. and a "Flexiprene" surround permits long cone excursions. Impedance: 15 ohms.



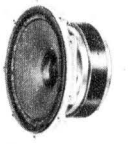
RS/12/DD
A wide range 12" loudspeaker designed to provide high fidelity in an enclosure as small as 2 cu. ft. Frequency response is 25-17,000 Hz. and power handling capacity is 30 watts peak. Impedance 12/15 ohms.

W 15/RS
This 15" woofer handles 40 watts peak power and frequency response is 25-1,500 Hz. Used with the Super 8 and a Super 3 (Crossover HS/400/3), a superlative three speaker system becomes available. Impedance of the W 15/RS is 12/15 ohms. Weight 13½ lbs.

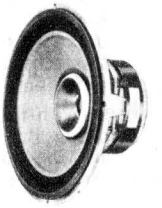


SUPER 3
An excellent tweeter with a frequency response of 1000-20,000 Hz. Aluminium voice coil, impedances 2/3 ohms or 10/15 ohms. Pole size 1", weight 3½ lbs.

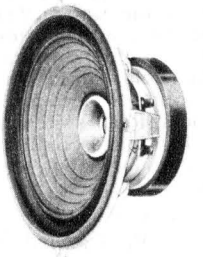
SUPER 5
Frequency response 400-17,000 Hz., impedance 10/15 ohms, pole size 1" diameter. Aluminium voice coil. Excellent for addition of presence in the middle register and a top quality H.F. reproducer.



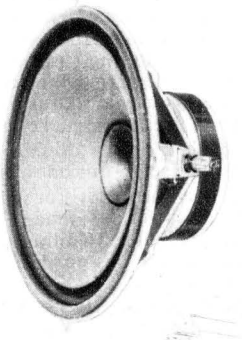
SUPER 8 RS/DD
With roll surround and double diaphragm, this high quality 8" wide range speaker features an aluminium voice coil. Frequency response: 30-20,000 Hz. Ideal for small enclosures; rated at 12 watts peak power. Impedance 10/15 ohms.



SUPER 10 RS/DD
A flux density of 16,000 oersteds gives the SUPER 10 higher sensitivity and outstanding transient performance; frequency response is 30-20,000 Hz. Used in a 2 cu. ft. enclosure excellent results are obtainable. Roll surround and double diaphragm. Impedance 10/15 ohms.



SUPER 12/RS/DD
The ultimate in domestic high fidelity loudspeakers. Frequency response is 25-20,000 Hz., and the SUPER 12 is rated at 40 watts peak output. Flux density is 17,000 oersteds. Pole size: 1¾". Impedance is 12/15 ohms.



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alloying process provides good adhesion and electrical contact between the aluminium and the surface. Without the alloy step the aluminium would readily peel off and lead bond pads would easily lift from the transistor surface. After alloying, the wafers are lapped to final size from the reverse side. At this point in the process, devices which will use the no-preform die attach have the gold backing applied.

Once the wafer has thus been metallised, it is ready to be die sorted, cut up, and mounted. The die sorting is performed with the wafer held rigid on a vacuum chuck. Each potential device is electrically probed, an ink dot marking the bad devices. Once die sorted, the wafer is mounted on a plate face up, again held tightly by a vacuum chuck. The wafers are scribed with a diamond point, and are then broken into dice.

The process of mounting the individual dice on to their "headers" is as follows:

(1) The header assembly is brought up to temperature approximately 400°C.

(2) The chip is placed in contact with the header. If reverse side gold is not used, a gold solder pellet or "preform" is placed on the header under the chip. The reverse-side gold applied to some devices eliminates the need for a solder preform.

(3) The solder preform or the reverse-side gold forms a eutectic bond between the chip and the header.

The next step is to attach leads to the mounted die, using one of two main procedures. If thermocompression ball bonding is used:

(1) The header carrying the die is raised to a temperature slightly below the gold solder melting point —350°C.

(2) A gold bond is made to the "capillary" lead.

(3) The gold capillary wire is resistance welded to the terminal lead "post" by another operator. The device is at room temperature during the welding operation.

If aluminium ultrasonic bonding is used, an aluminium wire is ultrasonically bonded at the same work station both to the die and to the terminal post. No heat is involved in an ultrasonic bond.

From here the devices are cleaned, baked, sealed, tested and shipped.

By far the most common method used for 100 per cent testing of transistors today is DC multi-parameter low-duty cycle testing, using a short duration pulse (typically around 400 micro-seconds). This is to ensure that the device is not overheated or destroyed when measuring parameters. Equally important, no appreciable change in parameters occurs due to heating of the junctions at the conditions specified. This possible change in parameters must be considered when comparing results of tests obtained by methods using long duty cycle or steady-state conditions.

Single parameter testing is occasionally required for special types or for specific customer requirements. These may be DC or dynamic tests and usually take about the same time per unit as a multi-parameter tester, which can perform perhaps 20 tests in one second. Obviously for economic reasons, variations to the basic specifications should be avoided wherever possible.

Dynamic tests in particular usually take longer, as most equipment designed for this purpose requires time to stabilise (particularly noise figure testers). In fact, repeatability of test results on a multi-parameter basis is extremely difficult and leaves some doubt as to their ultimate reliability. In general, Fairchild guarantees almost all dynamic parameters by the intrinsic properties of the device (Geometry-dopant level, etc.) and the successful passing of the DC tests on a 100 per cent basis.

Additional tests of a peculiar nature could have a dramatic effect on yield, involving more expense to the customer. As more devices have to be tested, more time is correspondingly taken, and the discard units may not then be easily disposed of—if at all.

Maximum and minimum gain devices are sometimes required and are difficult and time-consuming to find because of the processes in producing a given transistor for a given application. For example, when a certain application is determined, a transistor is designed so that maximum yield for the device will be centred around the desired characteristics. The wafers so produced are electrically sorted into classes to suit the published specifications written around

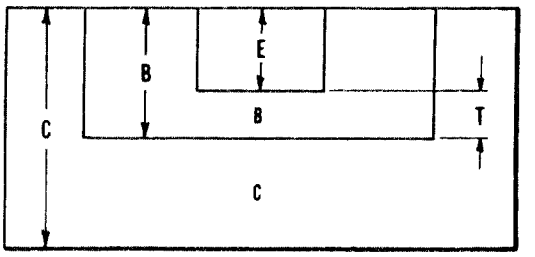


Fig. 14

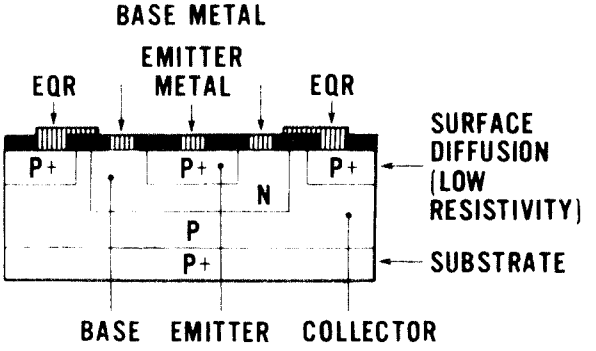


Fig. 15

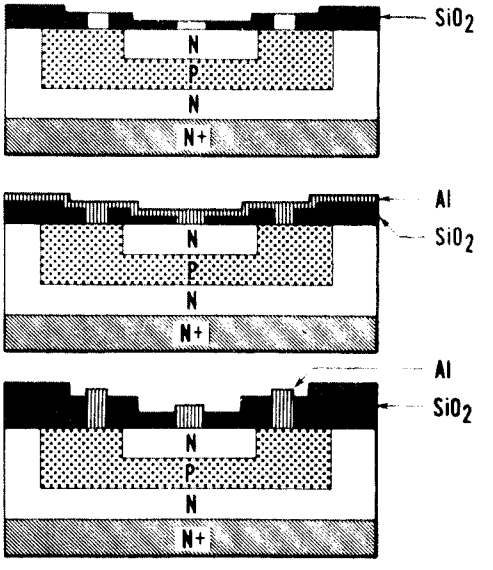
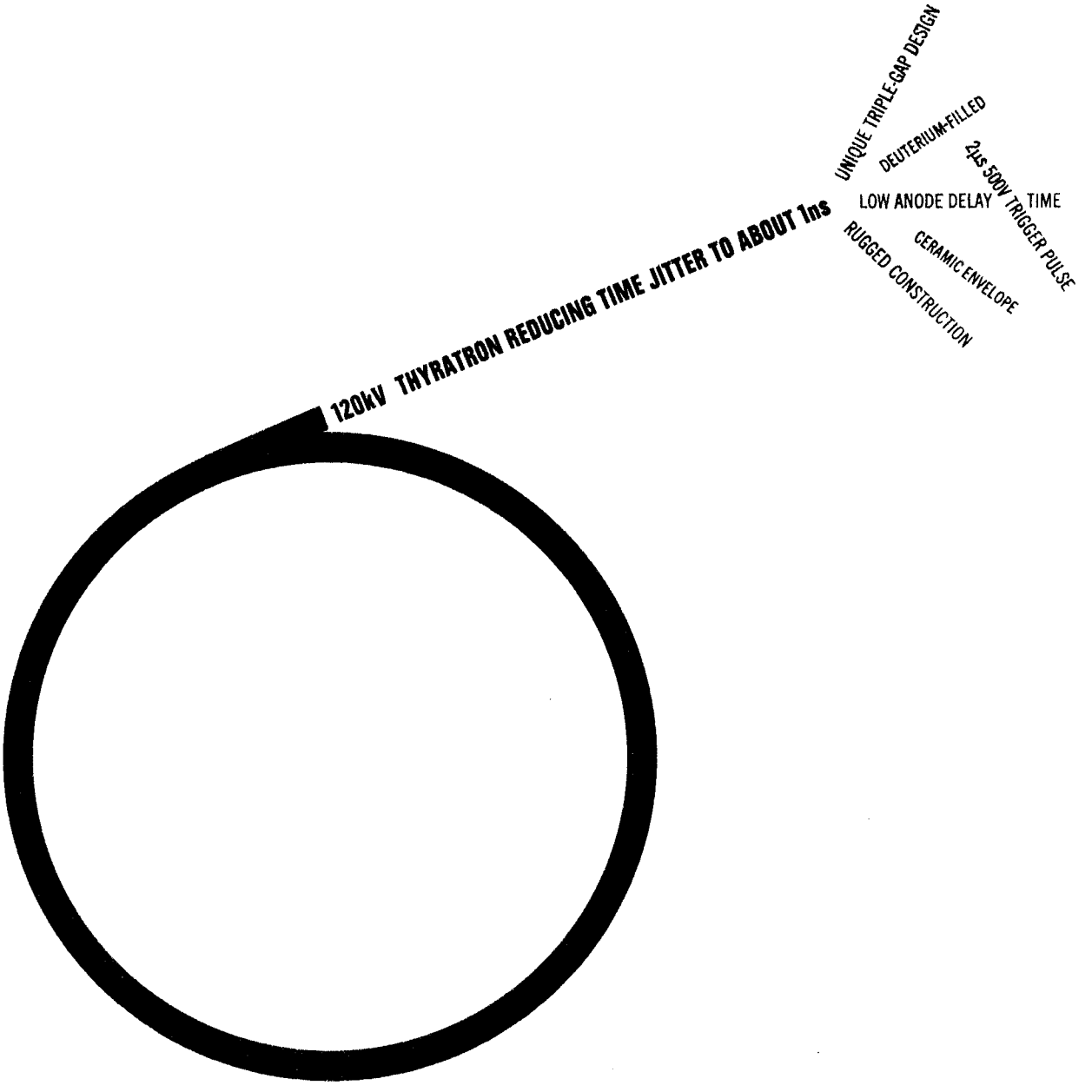


Fig. 16

the device. When certain types are required, the specific class of dice is chosen to ensure production of finished devices with maximum yield to the type required. This means that devices on the fringes are comparatively rare and thus hard to find.

Test equipment, such as the Tektronix Curve Tracer, is extremely useful for tests of this nature and also for correlation to specification conditions or evaluation of transistors to other than specification conditions. Providing the points mentioned earlier about dissipation are observed, correlation to pulse test conditions is not difficult to make.

In conclusion, it should perhaps be noted that all the testing in the world does not make a device more reliable. Reliability must be inherent in the process and design, and this is the aim of the Fairchild Planar process. ■



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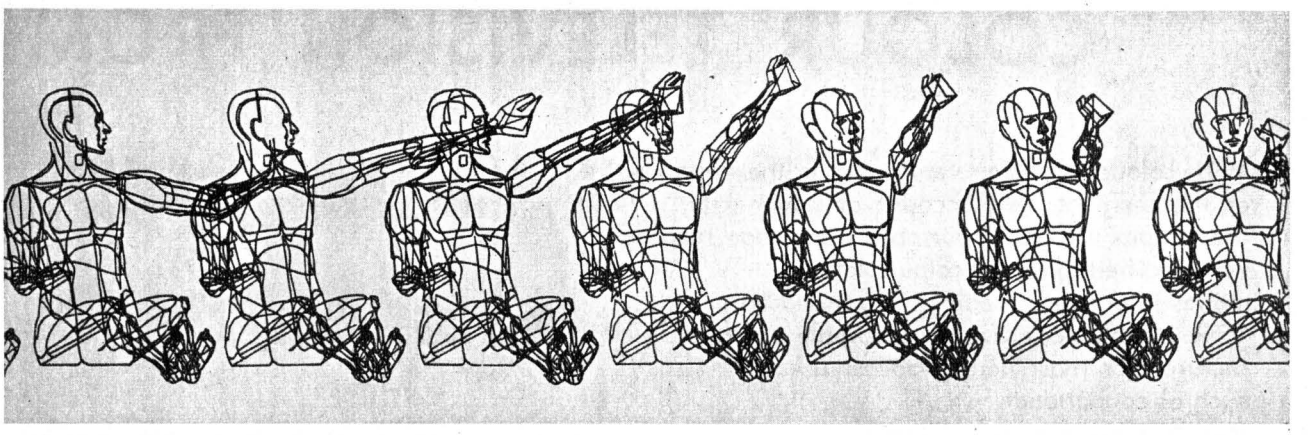


This is how a computer draws

MAN IN ACTION

The row of sketches above were drawn by a computer to illustrate the movements of airline pilots carrying out routine duties in flight. The principle would appear to show promise in all fields of time and motion study.

By Wes Robinson

Computers have been serving people obediently for years, solving their problems, setting up their schedules, making their reports, even keeping track of their bank accounts. Now, a Boeing computer has been given one of the most extraordinary human assignments of all — drawing animated sketches of man in action.

Design engineers who put together aircraft cockpits and controls must know how a pilot will react physically to a particular arrangement of dials and instruments. Are emergency controls too hard to reach? Are certain instruments in the wrong place? Can movement in the cockpit be reduced by rearranging seats or controls?

Manufacturing a full-scale model or mockup of every contemplated cockpit design to get these answers is expensive. Having a pilot run through simulated instrument checkout in each mockup would be time-consuming. So, before investing time and effort in this way, Boeing designers decided to let a computer figure out whether a certain-sized pilot could operate comfortably in the cockpit of a particular design. The computer would show pilot "reach" distances and movements with mathematical precision.

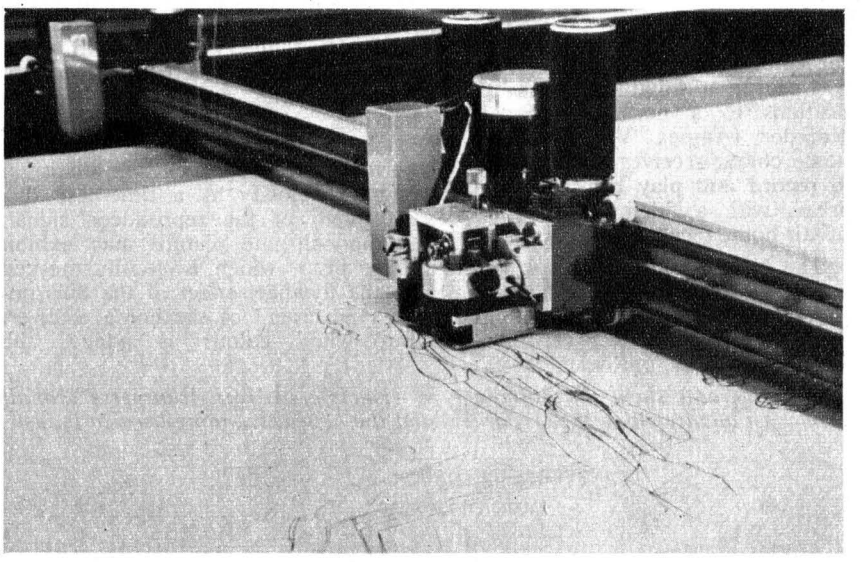
Drawing the human figure in action in the cockpit was the next logical extension of these computer experiments. Boeing's computer graphics organisation took the anthromorphic dimensions of a median pilot from Air Force data. If you lined up all the pilots by height, from tall to short, and again by weight, then by hat size and then by length of arm, the man in the middle or each line would, in order, stand 5 feet, 9 inch tall, weigh 162 pounds, wear a size 7-1/8 hat and have a 34-inch reach. This representative pilot was drawn in seven segments — the body below the waist, the torso, the head, the two upper arms and the two lower arms. Each segment was prepared for the computer with the same dimensional preciseness used in manufacturing parts for commercial jets. The result is a human figure that bends and twists with unusual realism, despite the fact that it is composed of only seven segments.

"We could spend more time animating the figure, of course," said Bill Fetter, computer graphics supervisor. "With 20 or 40 movable segments, we could probably bend the little finger of an animated figure. However, our purpose here is to find out as much as we can with the aggregates of movement available to us from a seven-unit figure."

The computer draws each part of the body as an individual unit. A graphics designer dictates where each section of the body will join the other, thus determining to a large extent the figure's action.

Fetter predicted it will soon become possible to store complete combinations of movement in a computer memory and call them out as total "subsets" with only one command, such as "run," "walk" or "bend." The computer would respond by drawing the appropriate combination of bodily segments in the requested pose.

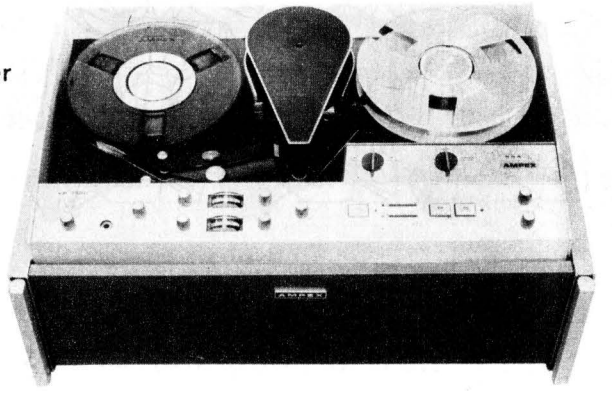
A cockpit to suit the tallest or the shortest pilot can be designed from the computer studies, as well as more comfortable aircraft seats, better leg rests and more convenient kitchen galleys. Space-craft designers find the computer sketches equally useful in determining instrument placement and cabin comfort for astronauts. Not only that, someday even Mickey Mouse may use a computer to help him in and out of animated situations. ■



Following programmed instructions, the computer draws action sketches of typical movements made by pilots.

COLOUR TELEVISION FROM

With colour television very much in the news at the moment, this account of how the Ampex VR-7000 portable video tape recorder was modified to record colour pictures makes interesting reading. The modified VTR is able to provide acceptable colour pictures for most non-broadcast uses such as educational, industrial and home applications.



By Joe Roizen *(Ampex Corporation)*

Recording colour television signals on magnetic tape has been practical since 1958 when the first compatible colour broadcast recorders went into service. These transverse studio machines use four heads which rotate at right angles to tape travel (figure 1). The machines also contain very complex circuitry and time-base correction devices. The circuits are necessary to achieve studio-quality N.T.S.C. playbacks that meet F.C.C. specifications for on-the-air transmission; such video tape recorders (VTRs) range in price from $40,000 to $100,000 in the U.S.A.

The development of inexpensive helical videotape recorders for monochrome industrial and home applications, coupled with the current interest in colour television has led to investigations into relatively simple, inexpensive ways to adapt these recorders for colour. The pilot-carrier principle has proved a suitable system. Modifications to a normal monochrome recorder (Ampex VR-7000) and a home colour receiver make it possible to record and play back colour programs with a fidelity approximating off-air home reception.

The N.T.S.C. colour signal is composed of "interleaved" monochrome and chrominance signals amplitude-modulated on an RF carrier. The monochrome portion of the video signal requires only that the horizontal sync coming from tape have less than 15% per sec. per sec. rate change for stable optional images. This is a fairly easy-to-meet requirement for modern videotape recorders with head-drum servos. The chrominance portion, however, has a subcarrier signal of approximately 3.58MHz. The instantaneous phase of this subcarrier determines hue in the reproduced image. One cycle of the subcarrier (360°) has a 0.279μS period, and a 10° error in sub-carrier phase will produce a noticeable hue shift. 10° represents only about 8nS. Allowing for the accumulation of record and playback errors, a time base of better than 4nS is needed to reproduce faithful colour pictures. Such an extremely fine time base is not easy to attain.

Any rotating mechanism is subject to undesirable movement due to mechanical and electrical eccentricities, dynamic imbalance, walking bearings, etc. The head-drum assembly in a video tape recorder will normally display such variations in angular velocity as a time-base displacement of the reproduced signal. A monochrome picture may exhibit slight jitter, which is usually masked by the flywheel effect of the horizontal sync circuit of the home receiver. But when colour is added, the rotating head displacements show up as constant changes in subcarrier phase and the image looks as though it has lost colour synchronisation.

The composite colour signal used for recording in the VR-7000-A (the colour version of the VR-7000) is also fed to a burst separator which phase-locks a crystal oscillator running at the colour subcarrier frequency (see figure 3). The output of the crystal oscillator is divided by 7 in a tuned circuit that yields 511KHz, as shown in figure 4. The 511KHz is then multiplexed at a 5 per cent level on to the FM signal applied to the recording head. The current through the head then has a 5 per cent pilot-carrier content. The level must be high enough to be detectable in the playback circuits yet low enough to minimise interference visibility in the reproduced image.

In playback (figure 5) the 511KHz signal is recovered at the head pre-amp output, and a bandpass filter isolates it from the FM signal carrying the video information. Two limiters amplify and clip the signal to a uniform level; the pulses now drive a Schmitt trigger whose square-wave output goes to a second bandpass filter centred at 3.58MHz, the 7th harmonic of the 511KHz pilot carrier. The 3.58MHz is amplified and fed out of the recorder to the chomin-

These diagrams show the difference in principle between transverse scanning used in broadcast quality video tape recorders and the helical scanning used in industrial models.

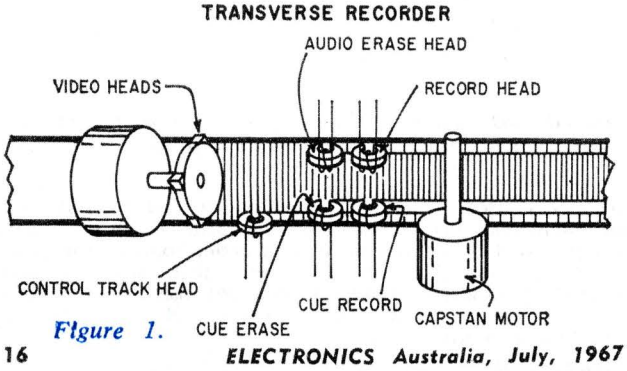


Figure 1.

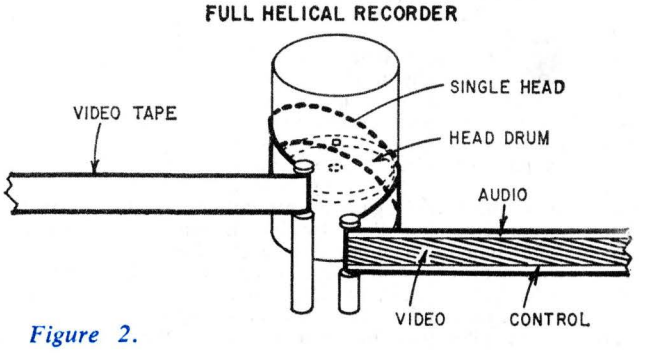


Figure 2.

HELICAL RECORDER

ance demodulation circuits of the modified home receiver. The set's own quadrature circuits form the 0° and 90° signals to decode the colour information.

Since the pilot-carrier signal is subject to the same time-base displacement errors that the composite video signal is experiencing, the time relationship between the pilot carrier desired signal remains constant. Hence the colour signal can be decoded with reasonable time-base accuracy. The local oscillator in the colour receiver is temporarily deactivated during VTR playback.

The signal system of the VR-7000-A (figure 6) must be able to handle a bandwidth of at least 4.2MHz to not attenuate the colour sidebands. To eliminate unwanted noise, spurious high-frequency signals, etc., the input is filtered by a phase-linear 4.5MHz low-pass filter network.

A fast-switching multivibrator-type modulator converts the video signal to FM. The carrier and deviation frequencies are somewhat elevated from their monochrome counterparts to minimise intermodulation effects between the FM signals and the high-energy colour subcarrier (figure 7). The modulator operates between 5.5MHz at sync tip to 6.6MHz at peak white. A rising pre-emphasis going up to 14dB at the colour subcarrier improves signal-to-noise ratio and differential gain and phase. The FM signal goes to a head-driver amplifier which provides a constant-current source to the recording head up to 15MHz. A rotating transformer with an 8-to-1 ratio transfers the amplifier output to the transducer. A 50-micro-inch head gap is employed.

In playback (figure 8) a low-impedance preamp gives a flat frequency response. Aperture correction and equalisation are applied to the FM signal before 50dB of shunt limiters eliminate variations in signal amplitudes.

The output of the limiter is a constant-amplitude FM signal. A pulse-count detector and a 4.2MHz phase-linear low-pass filter convert the signal back to video and remove residual carrier and deviation components. The output amplifier feeds two 75-ohm outputs, and the RF and IF stages of the monitor (receiver) must be bypassed to provide direct access to the video circuits.

A colour-kill circuit in the VR-7000-A detects the presence of bursts on the input signal and activates the pilot carrier in the record mode. If no burst is present, the pilot carrier is shut off so that the recording will not contain the 511KHz signal. Under certain background conditions, faint vertical lines can be seen in the playback image, due to interference from the pilot carrier. The level, however, is not high enough to be objectionable and with normal image conditions, is not noticeable.

The VR-7000-A colour VTR produces acceptable colour pictures for most non-broadcast uses, such as educational, industrial and home applications. (Reproduced by arrangement with "Radio-Electronics.")

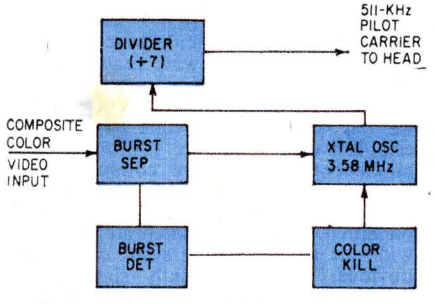


Figure 3. The pilot carrier is manufactured from the 3.58MHz reference oscillator signal during the recording process.

COLOUR TV ON DISC

Another significant advance in colour television recording technique is the development by Ampex of its HS-100 disc recording system. This is a high band colour recording system capable of providing instant replay at normal speed, or in slow motion and stop. This is made possible by the use of rare metal discs with extremely long life, in place of the conventional magnetic tape. Up to 30 seconds of action in high band colour can be recorded and played back with the new Ampex system.

For replay of significant action, any part of the 30-second recording may be cued for on-the-air use in four seconds. The system is also suitable for rapid low-cost production of colour commercials and special effects material. Its capabilities include reverse action playback at normal or slow motion speeds and frame-by-frame advance for animation or analysis of highlights. Any slow-motion speed down to stop frame can be chosen.

The HS-100 is the first model in a new class of rapid access video recording systems with the valuable capability for "instant replay" use in education, industry, medicine, government and other fields. Disc systems will be a useful complement to existing tape systems in those areas where fast access and variable playback speeds are more important than long playing time.

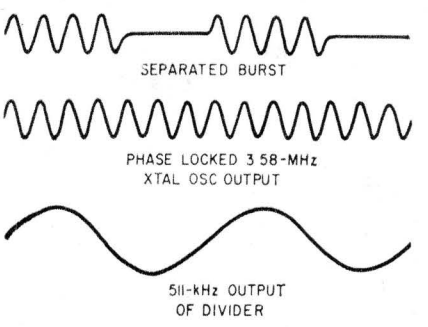


Figure 4. Burst-to-pilot relationship

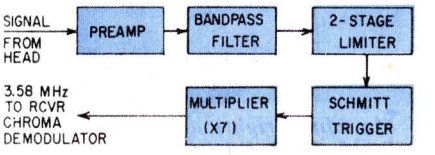


Figure 5. In playback, pilot produces burst.

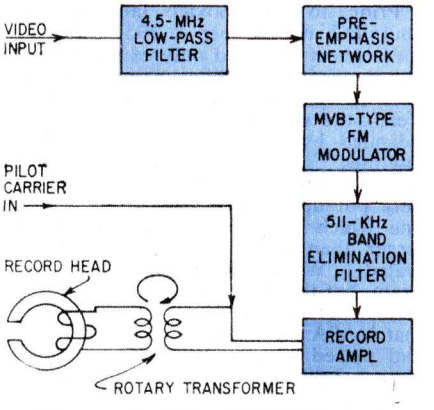


Figure 6. The VR-7000-A in record mode.

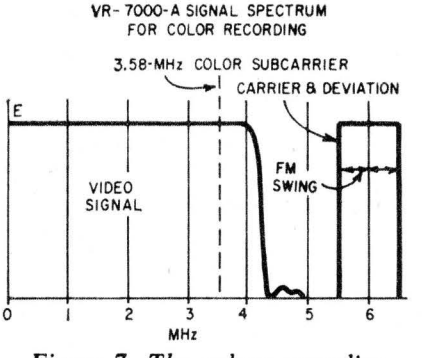


Figure 7. The colour recording bandwidth.

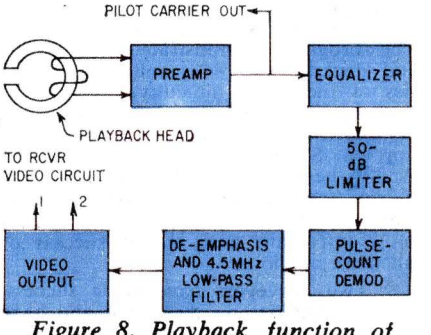
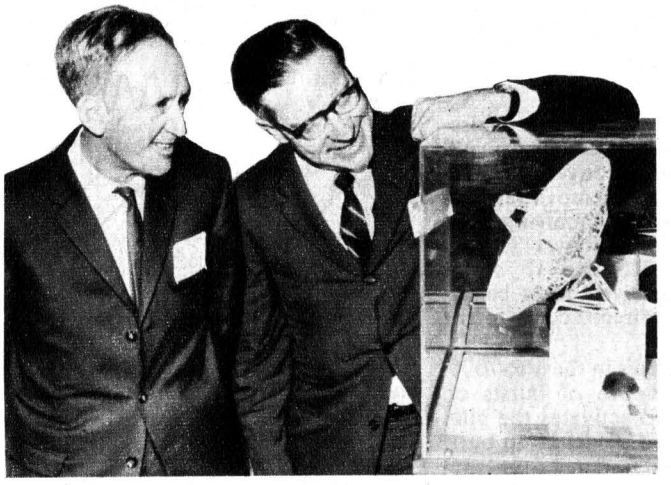


Figure 8. Playback function of VR-7000-A.

I.R.E.E. CONVENTION GUEST SPEAKER'S ADDRESS . . .



Mr Elms (right) and I.R.E.E. President Professor R. M. Huey inspect a model of a satellite receiving station at the convention display.

THE IMPACT OF SPACE

Presented at the Institution of Radio and Electronics Engineers Convention, Sydney, on May 23, 1967, by Mr J. C. Elms, Director of the NASA Electronics Research Centre, Cambridge, Massachusetts, U.S.A.

Prior to the Soviet launching of Sputnik I, on October 4, 1957, our own space plans consisted only of the launching of scientific satellites as our contribution to the International Geophysical Year—the satellites were of a size later ridiculed by Khrushchev as "grapefruit satellites." The United States was startled and shocked when the Soviet Union not only put up the first earth satellite, but one which weighed 184lb, considerably larger than anything we even contemplated. We accelerated our own program, but the Russians continued to orbit increasingly larger weights. At the time that NASA was organised in 1958 Russia had placed in orbit a satellite weighing almost 3,000lb. Our best effort up to that point weighed less than 40.

During that year of 1958, the United States tried to launch 13 satellites, but only five of them worked. Since that time, however, we began to have increasing success. By 1961, we had 54 successful flights, with five successes for each failure. Since 1963 our record of successful launches has been in the neighbourhood of 90%.

In those early years of the space age, we were limited in what we could do by the lack of launch vehicles capable of putting substantial payloads into space —and by the existing level of technology, as well as by inadequate knowledge of the space environment.

As progress was made on many fronts our understanding of the potential of space grew, and it became possible to raise our sights and identify more clearly longer-range goals. As you know, the Gemini program was successfully completed last autumn. During this program we put 20 men in space in 20 months. The program demonstrated rendezvous and docking and extra-vehicular activities of increasing difficulty. Three unmanned flights in the Apollo program demonstrated the performance of the uprated Saturn I launch vehicle, the Apollo heat shield, and the Apollo propulsion and navigation systems. The tracking station at Carnarvon played a most important part in the success of all these missions.

Two Surveyors have made successful soft landings on the moon and have sent back data of great importance. We have obtained Apollo landing site pictures from each of our three Lunar Orbiters. The cameras in the Lunar Orbiter also took pictures of the earth while it was in orbit about 750 miles from the moon's surface. The Woomera Station and Tidbinbilla, each functioning as part of a sub-net devoted to working with the appropriate spacecraft, performed beautifully. They received the data which produced spectacular and valuable pictures. All three of these programs, Gemini, Surveyor and Lunar Orbiter, have provided us with information essential to the projected moon landing.

During the past year the Orroral Valley Station obtained scientific data from about 40 satellites which measured the earth's magnetic and gravity fields, the characteristics and details of various radiation in space, atmospheric phenomenon, and other data which are helping us to understand better the environment which governs our planet. The Honeysuckle Creek Station is the newest member of the 16-station network which was implemented to support the manned Apollo mission. Honeysuckle Creek, together with two similar stations located 120° apart around the earth, at Goldstone Lake, California, and at Madrid, Spain, will give continuous coverage of the Apollo spacecraft from the time it leaves orbit of the earth, out to the moon, and back. These stations are equipped with 85ft-diameter dish antennas and provide tracking, communications and command.

They will receive communications from the astronauts when they are on the surface of the moon and will also receive scientific data from the moon emanating from experiment packages which the astronauts will leave on the surface of the moon. When the spacecraft returns and resumes earth orbit altitude, Honeysuckle Creek and its two sister facilities in California and Spain will return the communication responsibility back to the 11 network stations and two tracking ships which are equipped with 30ft-diameter antennas for near-earth and re-entry support. The Australian Government has provided additional assistance by making available physicians to serve as medical monitors at the tracking stations during manned flights. In addition, a number of Australian airfields have been used as staging area for recovery aircraft. These are some of the things for which I extend to you our thanks.

I am happy to say, however, that now we have jointly entered the era where the U.S. can give Australia more than thanks—where we begin to pay you back for your efforts with something more substantive than words.

At Toowoomba you have a prime command and control station for the Application Technology Satellite (ATS) series. This station provides us visibility of the satellite at that critical moment when we position it in synchronous orbit at an altitude of 22,300 miles. We have now reached a point in the space program where we can think beyond single purpose missions. The ATS carries a variety of space applications experiments in communication, meteorology, navigation and air traffic control, as well as environmental measurement experiments.

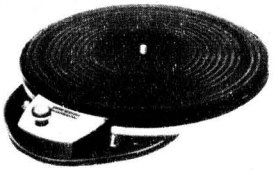
For instance, ATS I is permitting us, through its spin scan camera, to photograph the cloud-cover over the Pacific, the eastern coast of Australia, and the western coast of North and South America. We have been receiving about 20 cloud pictures a day over this area. This information comes into our own weather bureau and is combined with other information such as ESSA satellite data and ground derived data. By processing all these data, we can put together relatively long-range weather forecasts and weather maps. Furthermore, we can use the same satellite to send these facts back to all the stations that are in line-of-sight of the satellite, including, of course, Toowoomba.

At times it is difficult to contact aircraft flying over the wide reaches of the ocean because of the effects of varying atmospheric conditions. Using the ATS we have for the first time been able to establish experimentally continuous crystal-clear two-way voice communications between aircraft over the wide reaches of the Pacific and ground control stations on either side. The potential for world-wide air traffic control systems is indeed obvious. It is especially significant to future supersonic transport operations.

In addition to being involved in the ATS weather program, Australia also receives directly from U.S. satellites, twice a day, weather information in the

CONNOISSEUR CLASSIC TURNTABLE

Incorporating two slow speed synchronous motors, the Classic features a lathe turned aluminium turntable. Speeds are 45 and 33-1/3 r.p.m. Spindles are high quality carbon steel, mirror finished—and soft rubber wheels disengage when not in use. **Encel price** **$33.50**



CRAFTSMAN II TURNTABLE

Very popular overseas, the Craftsman II features two fixed speed and a full 12in. lathe-turned non-ferrous turntable. This precision instrument employs an hysteresis synchronous motor which is dynamically balanced—wow is 0.15%, flutter 0.1% and rumble—50 dB at RIAA characteristics when referred to 7 cm/sec. at 1 kHz. Ask for copies of reviews. **Encel price** **$49**

CONNOISSEUR CRAFTSMAN III TURNTABLE

Perfection in a precision 3 speed transcription turntable is the only way to describe the Craftsman III. Fitted with a 12" non-ferrous lathe turned turntable and a hysteresis synchronous motor . . . and a built-in illuminated stroboscope. Speed variation of 8% may be made. See the reviews in "Gramophone" and "Hi-Fi News" or write for your own personal copy. **Encel price** **$67.50**

CONNOISSEUR TONE ARMS MODEL SAU-1

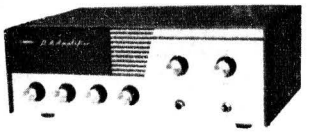
New stocks of this popular arm are once more available . . . ask for copies of the reviews. Bearings are silicone grease damped and are single point pivot types to reduce friction—an effective lifting/lowering device is standard. Height is adjustable—finish is nickel chrome and unbreakable black nylon plastic. Ask for copies of reviews **$18.50**

NEW CONNOISSEUR TONE ARM —MODEL SAU-2

A completely new model in a slightly higher price bracket than the Model SAU-1 which has been so popular. Gimbal mountings set at 45/45, automatic bias compensator, hydraulic lowering device, lightweight head shell, adjustable height, 0-6 grams precision stylus pressure adjustment . . . these are major features. Ask for copies of reviews. U.K. price is $A29.42 . . . Encel price including sales tax is **$29.50**

CONNOISSEUR STEREO CARTRIDGE MODEL SCU-1

Regarded as the finest ceramic stereo cartridge produced anywhere in the world, the Connoisseur SCU-1 will load any normal amplifier or tape recorder. Tip mass is 1 milligram, vertical compliance 8 x 10-6 cms-dyne, lateral compliance 12 x 10-6 cms/dyne. Sound qualities are exceptional—and include a pleasant musical transparency. Ask for copies of reviews in the "Gramophone" and "Records and Recording". **Encel price** **$10.80**



NEW PLANET MG-300 PUBLIC ADDRESS AND GUITAR AMPLIFIER

Power output is 35 watts R.M.S. with parallel push-pull 6BQ5's, frequency response is 30-15,000 Hz. plus or minus 2 dB. Three inputs-two crystal or dynamic microphones at 5 mV. and an auxiliary input for crystal or ceramic pick-ups, tape recorder or tuner at 300 mV. Output impedance includes 8, 16 and 250 ohms as well as a 70V line. Valve complement: 1 x 12AX7, 1 x 6AV6, 1 x 6AQ8, 4 x 6BQ5. Encel price is only **$73.50**

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A substantial shipment of Stentorian speakers has just arrived . . . compare **Encel prices!**

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WHAT IS AN EMQ?

Because of trade agreements many prices cannot be advertised so we advise you to write to us for an EMQ . . . an Encel Mail Quote. Please print your name and address in BLOCK LETTERS . . . and, if you're writing for amplifier or tape recorder information, please be reasonably specific as our stock of these items is extremely wide. Help us to help you!

IMPROVE STANDARDS WHEN RECORDING—DEMAGNETISE!

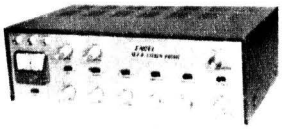
Two new tape head demagnetisers are now available . . . the single probe is Encel priced at $3.50 and the double probe only $3.00. Recording heads may be demagnetised in a few seconds and quality of recordings improved considerably. Essential for all tape enthusiasts.

INCOMPARABLE FERROGRAPH TAPE DECKS!

The new model 6G Ferrograph four track decks — stereo of course — have now arrived at Encel Stereo Centres. Three speeds, three heads and three motors. All the advantages of a world class professional stereo recorder can now be yours for a modest outlay. As agents for Ferrograph, Encel Electronics price for this proven professional tape deck is only $198 including sales tax **$198**

NEW JANSZEN SPEAKER SYSTEMS WITH ELECTROSTATIC ELEMENTS

The all new Janszen Z600 speaker system is revolutionary in design and construction — provides a magnificent "transparent" sound. Response is 30 to beyond 30,000 Hz. The natural treble response results from the use of Series 130 Janszen mid/high range radiators—electrostatic units with 176 push-pull sheathed conductors. The bass reproducer is the Janszen Model 350B dynamic. Impedance is 8 ohms only. Encel price is $178 for the Z600 . . . and the cabinet can only be described as a masterpiece. Finish is oiled walnut. Truly an audiophile's delight. Ask for copies of elated reviews **$178**



THE ENCEL CSM-40 M.F.B. STEREO AMPLIFIER!

The remarkable new Encel CSM-40 offers more features, more performance, more value . . . similar units are usually twice the Encel price. Output is over 15 watts RMS (over 35 watts I.H.F.M.) in each channel, frequency response is 20-40,000 Hz, input sensitivities are as low as 1.5 mV. Loudness control, rumble filter, scratch filter, separate bass and treble controls, tape monitor, headset jack, motional feedback control and circuitry, substantial grain-oriented output transformers . . . all are standard on the Encel CSM-40. The balance meter may be switched in and out of circuit . . . the filaments of the pre-amplifier are DC . . . the output of cartridges such as the ADC 10E and 4E will load the CSM-40 and provide excellent results. Above all, this stereo amplifier is most satisfying to sit and listen to . . . see and hear the CSM-40 at Encel Stereo Centres in Melbourne and Sydney. Mail orders will be care-packed and freighted anywhere. Encel price is only **$129**

COMPLETE RANGE OF HIGH FIDELITY WHARFEDALE SPEAKERS

All models are now in stock . . . write for EMQ's or trade-in valuations on your old equipment . . . investment in Wharfedale equipment can cost less than you thought possible!

THE NEW PLANET MG-1504 STEREO AMPLIFIER

This extremely well finished stereo amplifier is also a fine performer . . . with a total power output of 15 watts (I.H.F.M.) and a frequency response of 30-20,000 Hz plus or minus 2db. Speaker matching for 4, 8 or 16 ohms. Valve complement 2 x 12AX7, 1 x 6AQ8, 1 x 6CA4, 2 x 6BQ5. Encel price is only **$59**

A NEW HIGH QUALITY TONE ARM AT A LOW, LOW PRICE!

The new Encel-Nikka tone arm is a precision instrument and will track perfectly down to ¼ gram with suitable cartridges. The open front head shell accepts all standard ½" fitting cartridges—and the arm takes Ortoform and SME shells without modification. Miniature ball bearings are used throughout. An outrigger bias adjustment sets stylus pressure. Encel price is only **$19 (£9/10/-)**. See the review in "Electronics Australia", p. 123, Oct., 1966. **$19**

FILM INDUSTRIES MICROPHONES

The Model M-8A ribbon microphone is supplied as standard equipment with several professional recorders. 50-14,000 Hz. response, impediances available are 50, 200 and 50k ohms. Now only **$24.50**

TAPE BULK ERASERS

Now available . . . WAL bulk erasers! Spools may be wiped absolutely clean in only a few seconds. Use any AC power point **$24.50**

THE NEW COSMOS SW-30C STEREO AMPLIFIER

8 watts R.M.S. or 15 watts I.H.F.M. per channel. P.P. 6BM8's. Wide frequency response. Speaker matching 4, 8 and 15 ohms. Sens. for p.u. 5 mV. Headphone jack. **Encel price** ... **$69.50**

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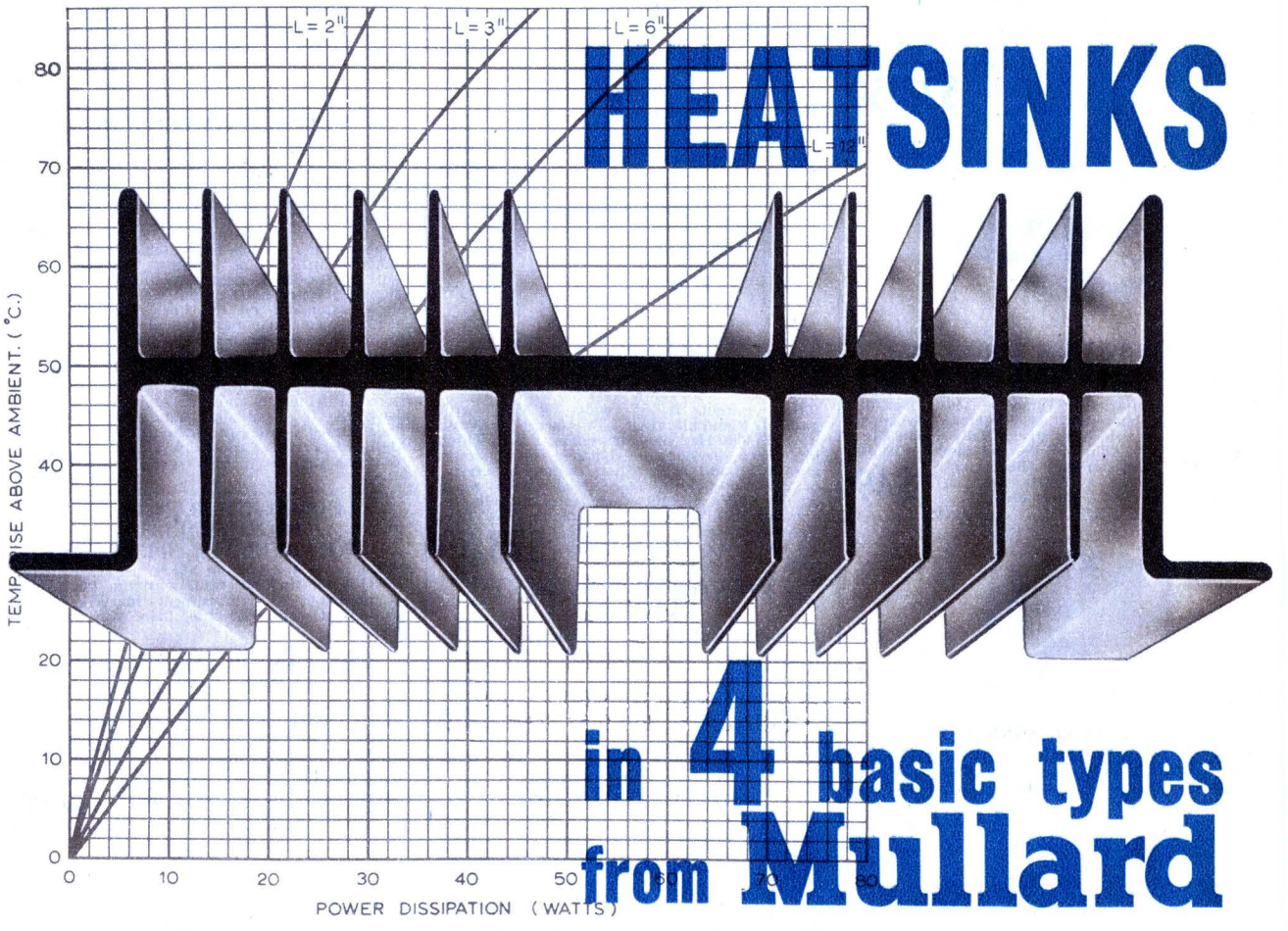


HEATSINKS

in 4 basic types from Mullard

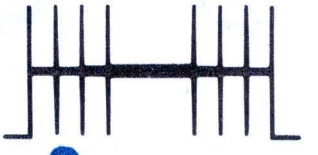
The Mullard preferred heatsink extrusions listed below are manufactured in Australia and offer design engineers "off the shelf" heatsinks for most power semi-conductor applications.

Type	Standard Lengths	Finish
35D	2" 3" 4" 6"	Anodised
45D	3" 4" 6"	Anodised
55D	4" 6" 8"	Anodised
65D	4" 6" 8"	Plain

Bulk material is available in 36" and 72" lengths. Non-standard lengths, subject to quotation, can be supplied in minimum quantities of 100 pieces. Further details are available from Mullard offices throughout the Commonwealth.

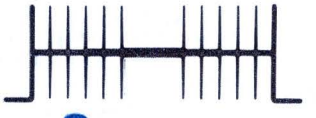
1 35D

For use with lower power transistors and silicon diodes.



2 45D

For use with medium power transistors, thyristors and silicon diodes.



3 55D

For use with high power transistors, thyristors and silicon diodes.

4 65D

For use with high power thyristors and silicon diodes under transient current conditions.

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M204

form of pictures showing cloud cover over Australia. The photographs are received by three automatic picture transmission (A.P.T.) stations in Melbourne, the University of Melbourne, and the W.A. Institute of Technology. I understand that three more A.P.T. stations are currently being installed in Darwin, Perth and Newcastle. I hope that the increasing number of meteorological data which will become available will be as helpful to the Australian economy as similar data have been to the U.S.A. For example, the U.S. Chamber of Commerce recently estimated that in its first year of operation alone, weather satellite forecasting has resulted in a saving of about $2½ thousand million.

Now, about our projected earth resources satellite program, particularly with regard to how this program may be valuable to your country in the near future in the important area of water resources management: It is my understanding that modern irrigation programs which have been established in N.T. have given indications that a tenfold increase in productivity can be achieved in both crop and livestock production by careful management of available water. Obviously it could be extremely important to your economy if you were able to locate additional water supply.

The experiments performed so far in our aircraft program have been very encouraging in this regard. Near-surface underground water has already been detected by infrared-photography. Deeper underground water can be located in some cases using a combination of optical, infrared and radar mapping techniques. In addition, sensors are available which can gather information on the density of vegetation, and on soil temperature and moisture. They may be used to distinguish a healthy crop from a diseased one and perhaps even point up the cause of crop diseases. Under-grazed and over-grazed conditions can be detected and, therefore, corrected. The productivity of the fishing industry may also be influenced by recording the movement of plankton and other variables affecting the migration of fishing grounds.

Unfortunately, it will be after 1970 when the global earth resources satellite program will become operational. Meanwhile, I hope interested Australians will visit the U.S.A.—to study our precurser aircraft earth sensor program—and to give us any advice that they think might be helpful in the development of the operational satellite system.

Some of our critics in my country have said that the space program diverts scientific and technical personnel from their normal occupations and goals, and is, therefore, damaging to the remaining sections of the economy. Most of us feel, however, that it is quite the contrary. We can say with increasing confidence that the peculiar quality of space science and technology provides a stimulus and an accelerating force for joint progress in a wide range of disciplines—astronomy, biology, geology, geodesy, mathematics, meteorology, physics, and others at their newest frontiers and, with the benefit of new tools, the rocket and the satellite.

Space technology is the practice of the established technical disciplines, including electronics, materials, structures, fuel, propulsion, communications, data handling and power sources under extremely severe conditions. The opportunities for scientists and engineers in our space program have obviously had a beneficial effect on universities in the U.S.A. I hope that Australian universities will have an increasing opportunity to participate in your space oriented activities as they develop.

Much has been said about the so-called race to the moon, involving Russia and the U.S.A. In the many discussions concerning the great expense involved, some of our critics forget that the lunar landing is not an end in itself but instead it is a focus for national effort. In this and other space programs, we are developing the tools and the minds and the strengths for future and greater enterprises. So also are the Russians; but I hope and believe that the space program can continue to be a substitute for the forcing element which was formerly provided only by great world wars—witness the development of the airplane and of nuclear energy as two examples.

Earlier I discussed the Apollo network — the unified S-band system in which Australia plays such an important part. It is interesting to note that an earlier NASA development, the communications satellite, now in its operational phase, will play an essential part in the Apollo development program. Furthermore it is an example of NASA's basic role in space. NASA is a research and development organisation, not an operational one. As the weather satellites have become operational they, like the communication satellites, have become the responsibility of another agency. Meanwhile NASA continues development of advanced systems to give the forecaster better tools such as multi-spectral imaging in Nimbus II.

Looking further into the future of weather satellites we can see the requirement for new technology in the area of sensors such as microwave radiometers and spectrometers as well as supercooled IR detectors; and in improved spacecraft equipment such as long life three axis stabilisation; and in data storage, processing and transmission. Also basic research is needed on new approaches for remote sensing of the atmospheric parameters.

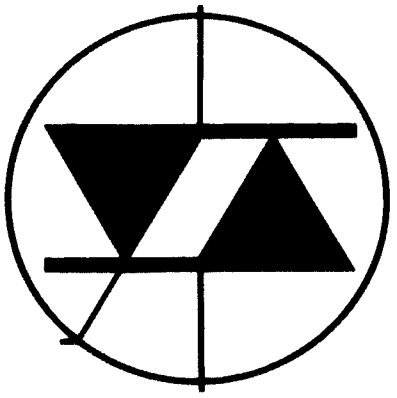
Although, I've only mentioned the word "electronics" once, I've been talking about electronics a great deal. Almost one half of NASA's money is spent on electronics and data handling —over two thousand million dollars per year! When I talk about requirements for the future I am talking about requirements for electronics.

No new technology requirement, whether it be for more efficient communications systems, for more accurate stabilisation and control systems or for more sensitive instrumentation can overshadow the most basic requirement for electronics with a much longer assured lifetime. One of the biggest limitations to longer duration flights is the reliability of electronic components and system. The best way to increase reliability is to design longer life into the basic devices. I don't want to downgrade the importance of system design in general or of redundancy in particular, but if you want something to work for five years you should design it so that you have every reason to expect it to work five years. Then and only then should you add redundancy to assure it's doing so.

The same design improvement which will permit longer duration missions will assure safer ones. These same improvements will reduce program delays and launch failures and will increase the probability of mission success. Last, but by no means least, greatly increased reliability of electronics is an essential requirement to reduce the cost of both the development and operational phases of the space program. Only by so doing can the advances in science and technology now being achieved be completely exploited for the economic and sociologic benefit of man. ■

STC CONVENTION STAND

Typical of the many excellent displays erected by companies participating in the equipment exhibition during the I.R.E.E. Convention was the STC stand, which featured radio transmission, data systems and line transmission equipment, as well as a wide range of components. A focal point of interest in this display was a 1/50th scale model of the high power rotable HF log periodic aerial designed in Australia for long and medium range communications with fixed or moving stations.



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Now the same General Electric technological leadership that over the years has brought you the Silicon Controlled Rectifier, the Controlled Avalanche Rectifier, high-current silicon rectifiers and many other important improvements in power semiconductor designs . . . makes possible TRIAC.

TRIAC is a new three-electrode AC semiconductor switch which is triggered into conduction in either direction by a gate signal. It's actually a power "integrated" circuit, basically related to the SCR.

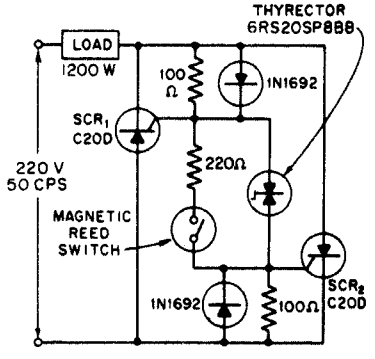
TRIAC simplifies control of full-wave AC power by *reducing the number of power-handling components;* by generally eliminating need for transient voltage suppression; and by reducing size and complexity of gate-control circuits.

Compare the two circuits below. Both show a full-wave AC static switch. The one on the left — the more complex—uses multiple SCR's. The simpler circuit on the right uses a single TRIAC.

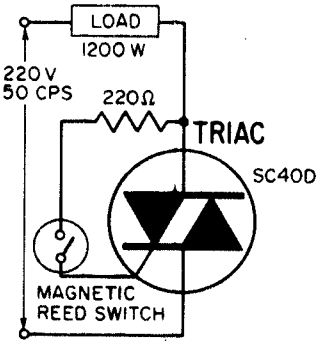
If you're interested in applications such as static power switching, temperature controls, lamp dimming or motor-speed controls, you should look into TRIAC.

It's available now, ex stock, in two current ratings; 6 amps and 10 amps both at 400 volts.

For further information, see your GE representative or write *Australian General Electric Pty. Ltd., 103 York Street, Sydney, N.S.W. — 29 8711, 552 Lonsdale Street, Melbourne, Victoria — 67 8221.*



This circuit can be simplified . . .



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Technical Review

AUTO DRIVER MAY PREVENT ROAD ACCIDENTS

With road deaths increasing each year, and more and more people being crippled in road accidents, anything which promises to contribute to road safety merits serious consideration by every road user. In this context, the news that a Japanese company has invented what they believe to be the first devices to keep drivers out of trouble by automatic means is of special interest.

Mr Densaburo Masuda is an elderly Tokyo businessman with an uneasy conscience about a serious social problem in Japan: the motor car. Japan already has nearly 10 million cars, of which about one-seventh are registered in Tokyo, where 788 people died in road accidents last year and another 58,454 were injured. At every police station the previous day's toll is prominently displayed. Masuda anticipated the menace 14 years ago when he sold his string of 20 English racehorses to finance a private dream — a research laboratory that might make a serious contribution to road safety.

"Most traffic accidents" Masuda said, "are caused by speeding or overloading." A few weeks ago his laboratory announced its first big contribution, a system whereby the top speed of a vehicle is automatically kept below a predetermined figure. Very soon now he hopes to announce a technical solution to the problem of the overloaded vehicle — in the case of dump trucks and forklift trucks often overloaded three-fold in Japan, he asserts.

The MEL automatic speed regulator, as they call it, has been developed jointly by a mechanical engineer, Shigeru Kondo, of the Masuda Electric Laboratory in Tokyo, and an electrical engineer, Minoru Moriya, of the Tsuken Electric Industrial Company in Sendai. Their idea is to impose a top speed limit upon the vehicle, beyond which the vehicle is automatically slowed down, or braked if need be. At its simplest, this control is exercised "voluntarily" by the driver, who merely pushes a button on his dashboard to select his own top speed (in Japan the limit is 80 kilometres an hour, but speeds of 40, 50, 60, 80 or 100KM/hour can be pre-selected).

But the real point of the MEL automatic speed regulator, is not to leave it to the driver but to impose an over-riding control from the pavement. Moriya has developed a miniaturised transmitter with a range of 300 metres — "the key to success," say his colleagues — that relays "instructions" to the vehicle. If the car enters a zone of restricted speed too fast, shortwave radio signals promptly close the throttle, and continue to override the driver's foot until the vehicle has slowed below the speed limit. A whole range of instruction can be relayed to the car in this way, so that it takes the appropriate action when approaching for example traffic lights, pedestrian crossings, no-passing signs, or icy road conditions. A simple extension of the scheme would allow tape-recorded instructions to warn the driver, audibly, of traffic signals and conditions ahead.

The heart of the MEL paging system's transmitter is a miniature oscillator called the Minifork developed by Tsuken Electric, which can hold its frequency to within four parts in 10,000 at room temperature (no frequency has yet been allotted for traffic control, of course). The idea is that the transmitter would be attached to or built into the traffic sign itself, at a cost the inventors believe of around $250 a time. The receiver, small enough to be fitted within, say, the thickness of the door, might be mass-produced, along with the mechanical coupling that disengages the accelerator, for about $75.

Mr Masuda's own white Cedric has been fitted for self-policing with the minimum system, and has completed 5000KM without trouble. It is said to slow the car abruptly, almost with a jolt, when a person tries to exceed the speed pre-selected on its dashboard. There is no need for any modification of the engine, and there is no effect upon the performance of the engine. The system has been undergoing public trials on the Funabasni Circuit, a race track north of Tokyo. Patents have been granted in Japan, and are sought in Britain and seven other countries.

The MEL system, plainly, is still experimental; but it works. It remains to be engineered for mass-production. The big obstacle, however, is that any significant advantage could emerge only if the system were to be adopted officially, and applied compulsorily to all vehicles. To this end Masuda and his colleagues have high hopes of influencing the Transportation Ministry, whom they claim has smiled favourably upon their ideas.

At the same time Mr Masuda, thinking nostalgically of that string of English racehorses, has hopes that Japan and Britain might collaborate in solving mutual social problems, traffic among them. ("New Scientist," 18/5/67.) ■

TRAFFIC LIGHTS THAT "THINK" AID U.K. DRIVERS

The dilemma of the driver who finds the traffic lights changing aspect as he approaches them at speed may have been eliminated by a system devised by the British Ministry of Transport's Road Laboratory scientists.

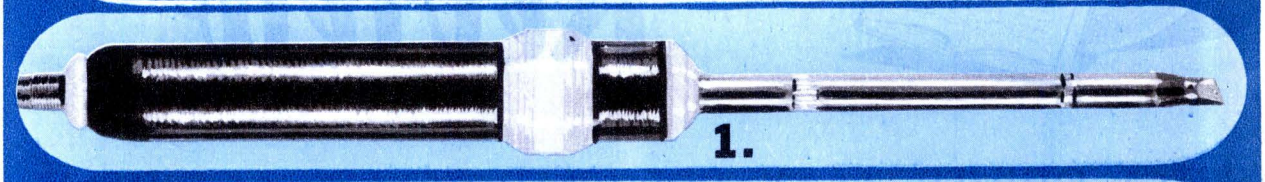
With this system, traffic lights will not normally change to amber in circumstances when a driver might have difficulty in stopping safely and comfortably at the stop-line. No extra signals are involved and there is no alteration to the normal three-second amber period.

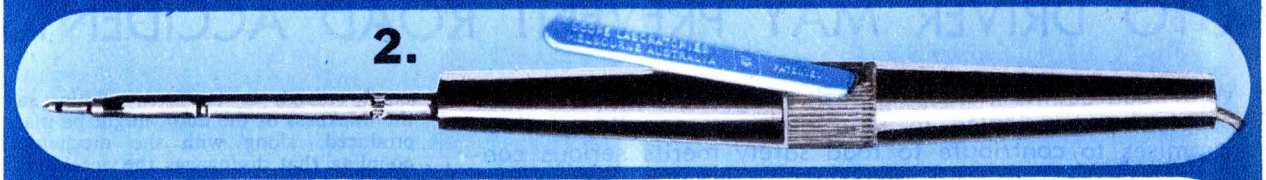
The equipment consists of detectors which measure speed, placed about 500 feet from the stop-lines on the high-speed approaches, and computing devices which estimate the time that each vehicle will enter its critical section. When a vehicle enters this critical section, the signal is held at green until the intersection has been negotiated, except when the green period has already been extended to the maximum time allowed.

After successful preliminary trials on the Kingston By-pass a prototype model has been constructed in association with Automatic Telephone and Electric Co. and Siemens and General Electric Railway Signal Co. Ltd. which is now under test. Equipment of this kind, which can be coupled to normal vehicle-actuated signal controllers, will be in production shortly.

The system and equipment are described in a Road Research Technical Paper (No. 74). It is available from H.M. Stationery Office. ■

THE BIG TWO SOLDERING IRONS BY - SCOPE

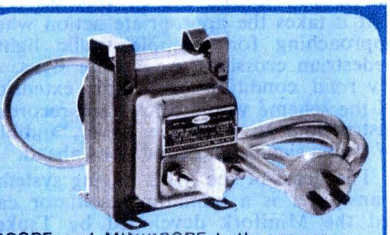




1. Scope—Gives big performance—will perform all the functions of conventional slow-heating irons rated from 40-150 watts—yet light in weight, only 3½ ozs.

Scope — Big on exclusive features: The light-pressure — "Switch-ring" means dependable operation, — no-metal-to-metal switch contact to burn out.

Switch-ring right around handle means that switch can be operated from any position. Big value at low cost, STANDARD Model, $5.50; DELUXE Model, $5.95. Little maintenance ever required, easily removable copper tip and carbon element rarely need replacing.



SCOPE and MINISCOPE both operate on voltages from 2.5 V. to 6.3 V. A.C. or D.C. or from 240 V. A.C. mains through a "National" Scope Transformer. Only "National" Transformers are fully approved by "Manufacturer." Fitted with 6 ft. 3-core flex and 3-pin mains plug.

MINISCOPE has a big heart for hard work

2. Big in versatility, small but sturdy, it allows easy access to confined areas. Ideal for work on minature components, as well as on larger items usually requiring a conventional iron of up to 75 watts. Big on speed—five seconds from cold, thereafter instantaneous. Heat only where, when and as much as needed.

Big on economy—only $5.28 AND light in weight, 1¾ ozs. MINISCOPE also features a slotted nylon centre-piece which is unbreakable and allows adjustment of switch-lever travel.

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SCOPE

INTELSAT III WILL COMPLETE WORLD-WIDE SATELLITE COVER

The transmission of live television pictures between Britain and Australia via a communications satellite in November last year focused public attention on what is, in fact, the second phase of a global satellite communications scheme planned to be complete by 1968. Telephone, television and teleprinter signals will be carried. This global system is being set up by the International Telecommunications Satellite Consortium (Intelsat), a partnership of 55 nations, and the second phase of the scheme is now under way. The first phase of the project was the coming into service of the Early Bird synchronous satellite in 1965. Phase II was designed to provide two additional synchronous satellites, one over the Atlantic and one over the Pacific (figure 1). Each has the same channel capacity as Early Bird but gives about twice the radiated power and has a larger service area.

The satellite intended for the Pacific was launched in October, 1966, but the apogee motor failed to put it into the required geo-stationary orbit 22,300 miles above the earth and the spacecraft is now travelling in an elliptical orbit. It was while this "rogue" satellite was temporarily above the Indian Ocean that it was in a suitable position to allow the Britain-Australia television relay. While it was over the Atlantic it enabled two-way telephone communication to be established between the Cable and Wireless ground station built by Marconi on Ascension Island and the American ground station at Andover, Main. In the satellite, the receiver operates in the band 6.285-6.405GHz and the transmitter in the band 4.060-4.180GHz.

A replacement for the "rogue" Pacific satellite was subsequently launched—modifications having been made to the apogee motor design—and was followed shortly by the Atlantic satellite. Meanwhile, Early Bird continues to operate, and will be in use up to 1968, when the third phase, using Intelsat III satellites, will come into operation. (If Early Bird fails before 1968 it will be replaced.) The combined capacity of Early Bird and the new Atlantic satellite will allow trans-Atlantic television transmission without interruption of other communications.

Phase III will provide three new satellites, one above the Atlantic, one above the Pacific and one above the Indian Ocean. Each will have a capacity of 1,200 voice channels. Their positions are not yet known but the Atlantic satellite will probably be further west than Intelsat II satellite shown in figure 1. A significant feature of this phase for the U.K. is that the Indian Ocean satellite will allow communication between Britain and Australia, using the U.K. Post Office's ground station at Goonhilly, Cornwall, and a ground station to be constructed by the Australian Overseas Telecommunications Commission. As can be seen from figure 1, Goonhilly and much of Australia are within the limits of the service area. These limits are described by points on the earth's surface from which the satellite appears to be just above the horizon (see top-left sketch in figure 1). More precisely they are points on the globe where the angle of elevation of the ground station's aerial bowl when directed at the satellite is 5 degrees (relative to 0 degrees, the horizon)—an angle which Intelsat have agreed as the lowest economic one for adequate signal/noise ratio.

The capacity of the Intelsat III satellites will be taken up during the 1970s. In general the satellite scheme will be complementary to the existing coaxial-cable long-distance telephone network — satellite communications becoming relatively more economical with increasing distance. An important factor in the timing of the whole system is the U.S.A.'s Apollo space project for eventual landing of men

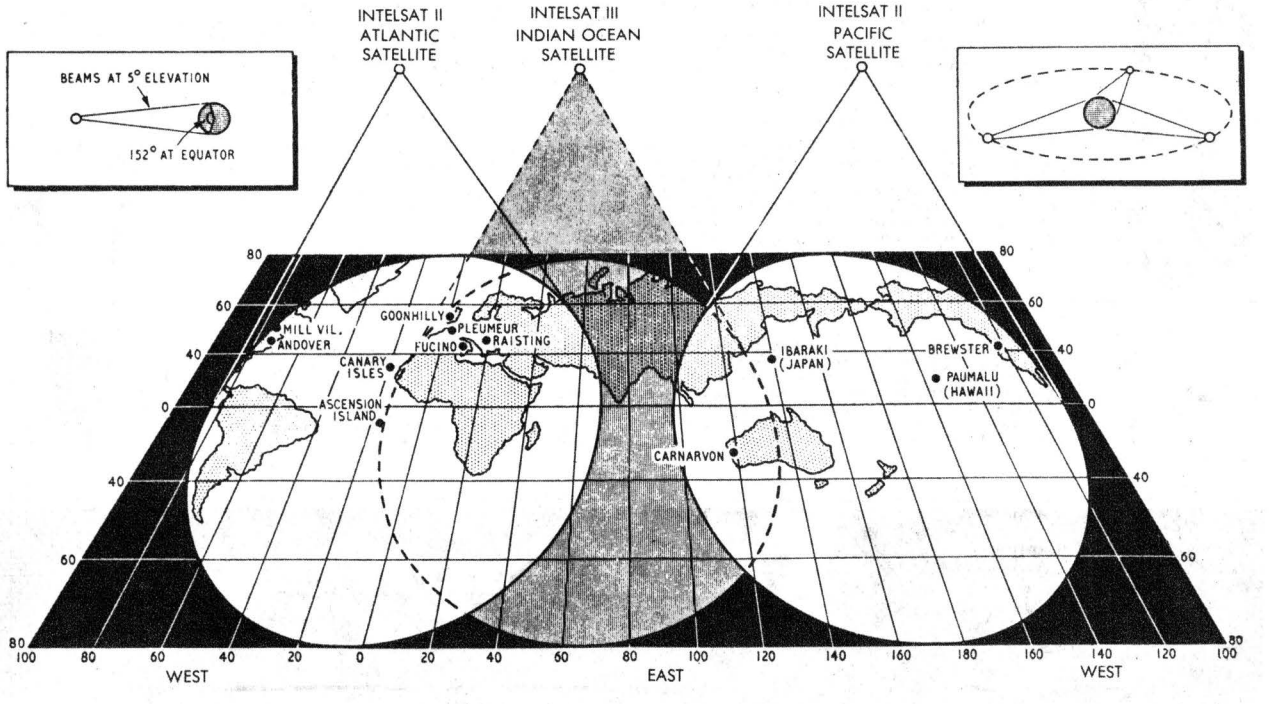

Fig. 1. Estimated service areas of Intelsat II Atlantic and Pacific satellites and probable service area of future Intelsat III Indian Ocean satellite. The Intelsat III Atlantic and Pacific satellites will have roughly similar service areas to those of the Intelsat II satellites but the Atlantic services area may be about 20 degrees further west.

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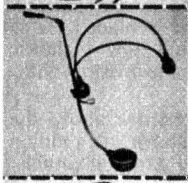
QUALITY ACOUSTIC PERFORMANCE . . . and unexcelled reliability have been the primary design criteria for Telex products for twenty-six years. This and superb Telex craftsmanship have built a reputation for product excellence that is our proudest possession.

WIDE PRODUCT RANGE
Shown below are selected products representative of the complete Telex line. Special products are designed and built to meet specific application requirements. A line of miniature switches is also available. Write for detailed information.

TELEX 1200—Dynamic headset with or without noise cancelling dynamic boom mic is new standard of excellence for education applications. Strain relief protects cords at wear points. A comfort to wear, yet shock, climactic and student proof.

STEREO-TWIN—Elliptical speakers deliver response of 16 to 15,000 cps for right and left stereo channels. Listening with the stereo-twin is a breathtaking new experience for even the experienced audiophile. Removable foam rubber cushions can be washed and sanitized.

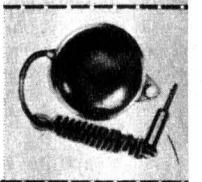


BOOM—MIKE HEADSET—Two-way communications unit is suitable for a broad field of applications, including switchboard, amateur radio, general communications. Standard equipment on intercontinental jets. Easy to slip on, simple to adjust, practically unnoticeable to wear. Mike boom is adjustable.

TELESET®—For inexpensive general purpose listening the teleset cannot be surpassed. The same high quality magnetic driver used in the magna-twin delivers full range response with excellent tonal quality. Rugged construction assures reliability. Completely field serviceable as are other Telex headsets.

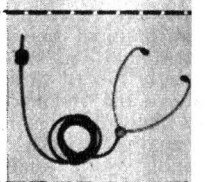
ADJUSTATONE—More stereo hi-fi performance and long lasting quality than ever before available at such an economy price. Big 3½-inch speakers, 10-15,000 cps. Rich styling complements any stereo set.

PILLOW SPEAKERS—With a Telex magnetic or dynamic pillow speaker, radio, tv, tape or phonograph programs can be enjoyed privately through the pillow without disturbing others. Very popular for bedroom late-tv viewing and in hospitals, nursing homes and motels. Diaphragm sealed against corrosion, dirt and moisture for reliable service.



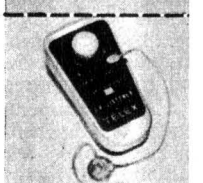
MAGNA-TWIN®—Rugged practicality and superior sensitivity of magnetic driver elements have won acceptance of the Magna-Twin with or without boom microphone as standard for language laboratories and communications. Frequency response: 50 to 10,000 cps.

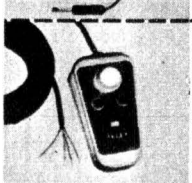
DYNASET®—An all purpose headset with pleasant tone, the light weight dynaset has hundreds of general listening applications. Receiver is located in "Y" with sound carried through acoustical tubing to both ears. 50 to 6,500 cps. Weight is only 1.25 ounces.



TWINSET®—A favorite of private and airline pilots, the twinset makes any Nav/Com system perform at its best. FAA approved, it weighs only 1.6 ounces, rests lightly at the temple with sound piped directly into the ear. Ambient background sound remains intelligible for cockpit conversation, yet full communication effectiveness is maintained.

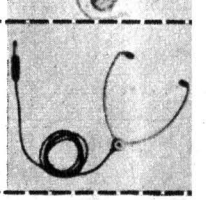
TV LISTENER—Listen to television through your private earset without disturbing others. Ideal for late night viewing. Widely used in hospitals, rest homes, motels and dormitories —wherever quiet must be combined with television entertainment. Two earsets may be used simultaneously. On-off switch and volume control at chair side.





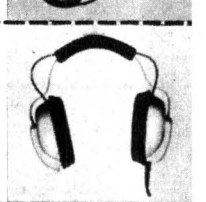
STEREO CONTROL KIT—The stereo control kit allows adjustment of stereo speakers by remote control from your chair. Two headsets may be plugged into the miniature control model which carries an on-off switch and volume control. Kit complete with simple instructions and 15 foot cord.

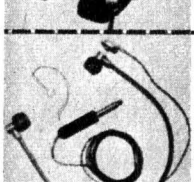
MONOSET®—The original under-the-chin lightweight headset for use with dictating machines, the monoset is a favorite of secretaries. Clear, clean sound reproduction makes dictation easier to understand. Light weight of 1.2 oz. allows efficient transcription for extended periods without fatigue.



INTEGRAL-CONTROL STEREO-TWIN—The only headset to provide ideal stereo balance under all listening conditions. Smoothly styled control knobs on each earpiece provide separate sound level control for each channel. The same superb sensitivity and response that has won wide audiophile acceptance for the standard Stereo-Twin headset. Now add integral channel control for ultimate headset enjoyment.

SERENATA—The finest stereo headset money can buy. Perfection performance with such exclusive deluxe features as adjustable ear cup pressure, electronic tone control, detachable cord, liquid-filled or foam cushions.





TELE-FI®—The tele-fi gives 30% better understanding of speech because the single speaker delays sound to one ear imperceptably for greater "depth of sound." With replaceable foam eartips, unit includes plastic earframes for use as a single earset. Excellent for monitoring, phone order boards, office machines.

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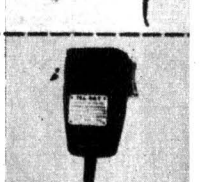

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on the moon. This will require global telecommunication links between the various radio stations tracking the spacecraft, and the Atlantic and Pacific satellites will be needed by NASA to supplement existing cables and HF radio systems. Ascension Island, mentioned earlier as an earth terminal station, is one of three places at which fixed Apollo tracking stations will be operating (the other two being Carnarvon and Grand Canary Island). A further six tracking stations will be mobile — on land or shipborne. About half of the capacity of the two Intelsat IIs will be used for the Apollo project and the remainder will be available for routine commercial communications.

The two Intelsat II satellites have been constructed by the American firm which built Early Bird (HS303)—Hughes Aircraft Company. These Intelsat IIs are twice as large as Early Bird, have over twice the radiated power, serve a larger geographical area and unlike Early Bird, provide for multiple-access working (meaning that a number of ground stations can work through a satellite simultaneously). The microwave relay station of the craft consists basically of a receiver operating over the band 6.285 to 6.405GHz, a frequency changer which changes the received signals by 2.225GHz and a transmitter radiating the frequency-changed signals in the band 4.060 to 4.180GHz. In the transmitter four 6W travelling-wave tubes are provided. One, two or three of these in any combination may be turned on and operated in parallel, according to the power available from the solar-cell and nickel-cadmium battery power supply (nominally 85 watts). Normally two or three TWTs will be in operation, even when the earth obscures the sun. These transmitter output tubes feed a four-element biconical horn aerial array, which has virtually constant gain across the pass-band, to give an ERP from the satellite of about 25 watts for multiple-carrier working or 35 watts for single-carrier working. Since the aerial array has a toroidal beam it continually illuminates the service arc on the earth while the satellite is spinning on its own axis (the spacecraft being spin-stablised).

Within the 125MHz bandwidth of the relay station, 240 two-way voice channels or one television channel can be accommodated. The cost of operating one two-way voice channel is at present about $35,000 p.a., but this is likely to drop as satellite communications become established. A transmission time delay of 270ms in each direction is inherent in the system, and this means that two such satellite "hops" used in tandem would make telephone conversations extremely difficult.

The craft's telemetry system, for monitoring and controlling the satellites from the ground, is similar to that of Early Bird and comprises two encoders, two VHF transmitters (which are turned on and off from the ground) and a radio beacon (which radiates continuously). Control of the satellites — positional control through gas jet system and control of the radio system — is the responsibility of the Communications Satellite Corporation (Comsat) in the U.S.A., which acts as manager of the whole scheme for Intelsat. Commands are sent from Comsat's operations centre in Washington, D.C.

The Intelsat III satellites are being constructed by the American company TRW Systems, and six are on order. These will have slightly greater transmitter power than that of Intelsat II but, because the aerial beam will not be an "all-round" toroidal one but have all the radiated energy directed in a cone towards Earth, the ERP will be substantially greater — about 100W in fact. This directional beam will be achieved by an "electronically despun" aerial system which will counteract the effect of the stabilisation spin of the satellite by cyclically switching the RF energy to the aerial elements as the satellite rotates. The greater capacity of these satellites will be provided by the wider bandwidth of the microwave relay stations — 500MHz instead of Intelsat II's 125MHz — the receiving band being 5.935 to 6.425GHz and the transmitting band 3.700 to 4.200GHz.

On the ground a number of stations are, of course, already operating through Early Bird, but many more are under construction and projected. Those already built or in course of construction are: Andover (U.S.A.), Brewster Flat (U.S.A.), Buitrago (Spain), Fucino (Italy), Goonhilly (U.K.), Ibaraki (Japan), Bill Village (Canada), Paumlu (Hawaii), Pleumeur Bodou (France), and Raisting (Germany). Although primarily for use in the Apollo project, the following stations will also be available for commercial communications: Ascension Island (British), Grand Canary Island (Spanish) and Carnarvon (Australia). In addition, there are

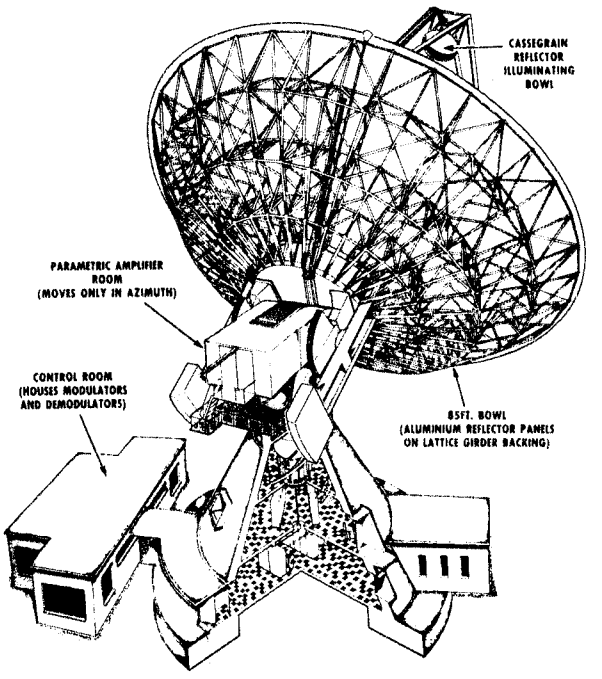

Figure 2. Earth satellite station designed by the A.E.I./G.E.C./Plessey consortium.

plans to build stations at Hong Kong, Bahrein (Arabian Gulf), Moorefield (U.S.A.), Moree (Australia), in the Caribbean, and second installations at Goonhilly and Andover. Countries with definite plans to build stations include Thailand and the Philippines, and further possible sites are Nigeria, Ethiopia, the Middle East, Chile, and East Africa.

It has been estimated that 80 to 100 new ground stations will be needed over the next few years. This, of course, represents considerable business for the manufacturers (each station costing $2.5m or more), and on the strength of it a new company, World Satellite Terminals Ltd., has been set up in Britain to specialise in building and installing these stations. Formed as a consortium by A.E.I., G.E.C. and Plessey, W.S.T. have produced a standardised basic design for a ground station and have tendered for the Hong Kong and second Goonhilly terminals. One feature of their design (figure 2) which uses an 85ft Cassegrain aerial reflector system, is that the "pre-amplifier room" containing the parametric amplifier first stage of the receiver is mounted so that it does not move in elevation when the bowl is tilted. This allows the equipment in the room to be continuously accessible to the engineering staff while the station is operating. The aerial bowl, as in other designs, is made steerable to permit tracking of non-synchronous satellites, or of synchronous satellites with slight positional variation (when the orbit is not precisely over the equator), or to allow the station to operate with two different satellites at different times. Maximum rate of movement is 1 degree a second. The aerial has a beam width of 0.2 degrees and can be positioned with an accuracy of 0.03 degrees.

Most of the ground stations in use or being built have reflector bowls 85ft in diameter. This is the minimum size necessary to satisfy a receiving-performance figure of merit recommended by Intelsat:—

$$\frac{\text{Aerial gain}}{\text{System noise temperature in deg. K.}}$$

expressed in decibels. In the W.S.T. station, for example the figure of merit achieved is 40.7dB with 5 degrees aerial elevation at the reception frequency of 4GHz. The basic problem is, of course, the strictly limited radiated power from the satellite and the irreducible noise level of the system (sky noise plus man-made radio interference plus receiving equipment noise). In practice this means that the aerial bowl should be 85ft in diameter to collect sufficient RF energy from the satellite, the station should not operate with the aerial beam lower than 5 deg. elevation, as mentioned earlier and the system noise temperature must be brought down to 50 to 60 degrees K. ("Wireless World," February, 1967). ■

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The UNIVERSITY High Impedance Vacuum Tube Voltmeter model MVA6 has been designed for utmost versatility and high stability coupled with minimum of controls and simplicity of operation.

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DC Volts:— (negative or positive)
0 - 1.5 - 5 - 15 - 50 - 150 - 500 - 1500 V DC
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H.V. Probe (HV.20) up to 30KV.

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DB:— Ref. level 1mW in 600Ω line.
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Accuracy:—± 3% for DC Ranges
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Power Supply:— 220 - 240 V AC 50 cps.

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Dimensions:— 5.5" x 9.5" x 6" (140 x 215 x 152mm)

Weight:— 5.5 lbs (2.5 kg.)

FEATURES:

Large, 3 colour, Easy to read scale

Engraved Aluminium Front Label

Unbreakable front cover on meter

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Rugged Steel Case finished in 2 tone grey Baked Enamel.

Complete with — Test Leads, Instruction Book and Battery.

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Dimensions 9¼" (250mm) Weight 5oz. (140 gr.)
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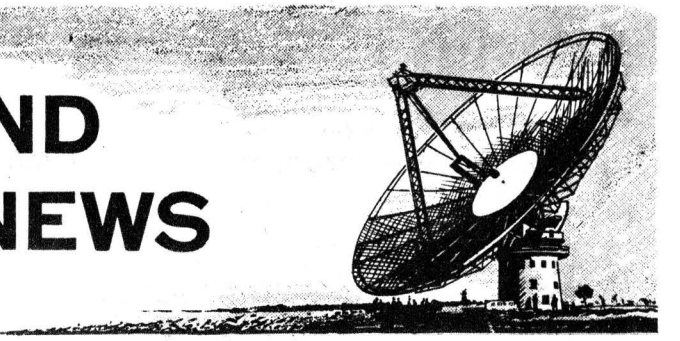
SCIENTIFIC AND INDUSTRIAL NEWS



Australia's World Weather Centre

Weather information of vital importance to Australia's primary industries, airlines, shipping, and others, will soon be processed by a new computer centre. The Commonwealth Bureau of Meteorology will install the computing facility in Melbourne using a large IBM computer complex costing about $4 million. The new centre will be linked by a communication system with meteorological data sources and information users throughout Australia and overseas. It will play an important role in the World Weather Watch, with the responsibilities of a World Weather Centre, together with similar centres in Washington and Moscow, exchanging global weather data and charts.

To help local weather forecasting, the computer will process continuously data from nearly 1,000 stations supplying meteorological observations from Australia and the adjacent regions. With these data, the centre will assist in issuing forecasts — including warnings of weather conditions likely to be dangerous — plot weather charts, compile lists of selected observations, carry out statistical processing, and generally apply the latest principles of data processing to the Bureau's main functions.

Electronic equipment in the centre will include two identical processors with high speed printers, and magnetic disc drives capable of storing and keeping up to date vast quantities of weather data. The peripheral equipment will also include magnetic tape units, visual display stations capable of retrieving and displaying in seconds tabulated weather data. Graphic plotting equipment linked to the central processor will automatically plot weather charts showing the movement of weather patterns over Australia and adjacent geographic areas.

The complete computing and communication system will not become operational for some time. It will be installed in two phases over a number of years, starting in mid-1968.

Electronic telephone exchange

Europe's first regular electronic telephone exchange was opened at Ambergate in England recently. The British Post Office has placed further orders for similar exchanges but, at the same time, has placed large orders for electromechanical crossbar equipment. For future projects, it has standardised on electronic exchanges up to 2,000-line capacity, but will still depend on modern crossbar equipment for larger exchanges.

The exchange at Ambergate is not fully electronic in the sense that there are no moving parts. All control circuits are electronic, but the mechanical crosspoint still depends on physical movement for operation. Totally electronic exchanges with no moving parts have been tested under operating conditions in the United States and Britain. However, in recent years there has been a swing from total electronic switching to mechanical crosspoint with physical movement.

Australia may not see the introduction of electronic exchanges for several years, but the Australian Post Office will carefully evaluate reports on the performance of the Ambergate exchange. There appears to be no reason why electronic exchanges will not readily be integrated into the existing telephone network.

Enlarged University Computer Systems

Control Data Australia Pty. Ltd. has contracted to supply additional computer equipment to Monash, Sydney, and Western Australian universities at a total cost of over $200,000. The first of the equipment has already been delivered.

The computer system at Monash is being doubled in capacity by the addition of an extra 16,384 words of central memory and two data channels. Two disk drives, each of 4 million characters, are also being added. The system installed at Sydney University is being enlarged with the addition of six telegraph terminal units, two disk drives each of 8 million characters and a C.R.T. display station. The University of Western Australia has also ordered two disk drives of 8 million characters to add to their computer.

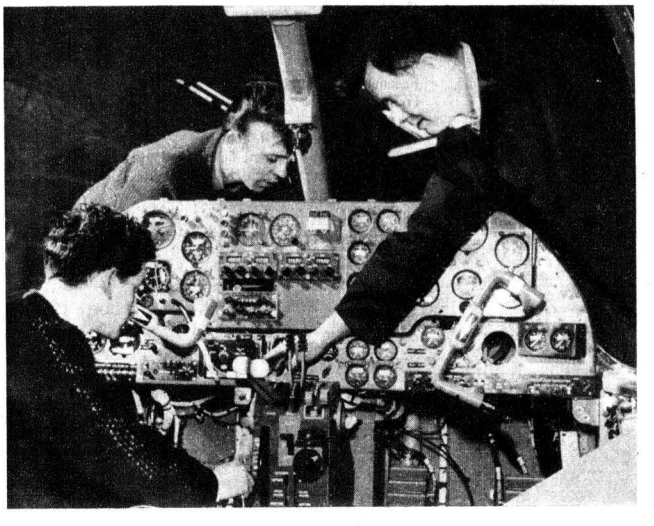
Simpler computers now possible

Original research work carried out at Edinburgh University may lead to computers which are smaller, faster and much cheaper than existing types, according to a report in "The Scotsman." Professor W. E. J. Farvis, and a microelectronics team at the university have discovered a method of drastically simplifying the complex communications system within a computer. Basically, the principle of the Farvis team's work is a simple one, making use of basic bulk effects in semiconductor material — in this case a thin film of cadmium sulphide atoms evaporated on to a glass slide. A minute piece of this material should ultimately replace the complicated integrated circuits now widely used in computer circuitry.

Stable high electric field domains (clusters of electrons) are launched across the cadmium sulphide with the application of voltage. If a domain moving through the material encounters changes in conductivity due to doping or changes in cross-sectional area, the current through the slide also changes. By specifying the conduction paths in this way, it is possible to produce an output current with a waveform of almost any shape. The new concept has been named DOFIC (domain originated functional integrated circuits).

Although the silicon integrated circuit is reliable and reasonably cheap, the fabrication process is fairly complicated. The advantage of the new method being developed at Edinburgh is its simplicity. For instance, the pulse generator is an integral part of a digital computer, but at the moment it takes as a minimum, two transistors, at least four resistors and three capacitors to make one pulse generator. With the DOFIC circuit, every time a domain sweeps across the DOFIC element it can generate a pulse corresponding to a notch cut into the profile. In fact a pulse code can be generated if more than one notch is cut into the element, giving an easy way to generate binary numbers. Because the domains travel through the element very quickly (at something like 10,000,000 centimeters per second) an extremely short pulse is generated. Short pulses mean very much faster computers.

At the present stage of development of the system, the thin

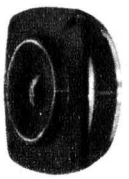


Electricians wiring the instrument panel of a B206S twin-engined six to eight seater executive aircraft, manufactured by Beagle Aircraft, England. The fiftieth of this series will shortly be delivered to the Australian Royal Flying Doctor Service. The plane has 221 cubic feet of cabin space. It is claimed to have all-weather capability, a range of 1,500 miles, and a cruising speed of about 222 m.p.h.

foster hi-fi speakers

High Compliance tweeters

FT-502

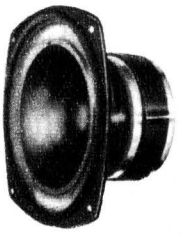


SPECIFICATIONS
Size : 50 mm (2 in.)
†Impedance : 8 or 16 Ω
Frequency Range : 2,000 ~ 20,000 c/s
Sensitivity : 100 dB
Power : 30 W max., 8 W nom.
Dimensions : 82 × 82 mm, 29 mm depth
Magnet Weight : 193 g (6.81 oz), Ceramic
Weight : 615 g (1 3/8 lbs)

Price $8.04.
Plus Sales Tax $1.68.

High Compliance woofers

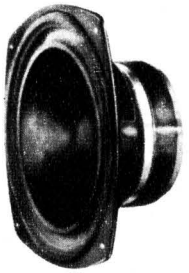
FW-162



SPECIFICATIONS
Size : 160 mm (6 1/2 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_0) : 40 ~ 50 c/s
Frequency Range : f_0 ~ 2,000 c/s
Sensitivity : 97 dB
Power : 30 W max., 10 W nom.
Dimensions : 166 × 166 mm
81.6 mm depth
Magnet Weight : 500 g (1 1/8 lbs), Ceramic
Weight : 1,660 g (3 11/16 lbs)

Price $12.00.
Plus Sales Tax $2.50.

FW-202

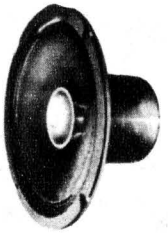


SPECIFICATIONS
Size : 200 mm (8 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_0) : 30 ~ 40 c/s
Frequency Range : f_0 ~ 2,000 c/s
Sensitivity : 98 dB
Power : 45 W max., 15 W nom.
Dimensions : 208 × 208 mm
90.8 mm depth
Magnet Weight : 830 g (1 13/16 lbs), Ceramic
Weight : 2,760 g (6 1/16 lbs)

Prices $23.64.
Plus Sales Tax $4.93.

Double-cone speakers

PW-65A



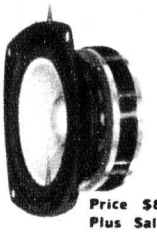
Size : 160 mm (6 1/2 in.)
*Impedance : 8 Ω
Resonant Frequency (f_0) : 70 ~ 100 c/s
Frequency Range : f_0 ~ 15,000 c/s
Sensitivity : 97 dB
Power : 6 W max., 5 W nom.
Dimensions : 164.9 ϕmm, 86.2 mm depth
Magnet Weight : 77.6 g (2.73 oz)
Weight : 476 g (1 1/16 lbs)

Price $6.60.
Plus Sales Tax $1.35.

*at 400 c/s; †at 3,000 c/s

High Compliance wide range speakers

FE-103



Price $8.64.
Plus Sales Tax $1.04.

Size : 100 mm (4 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_0) : 65 ~ 95 c/s
Frequency Range : f_0 ~ 18,000 c/s
Sensitivity : 96 dB
Power : 5 W max., 3 W nom.
Dimensions : 105 × 105 mm, 46.6 mm depth
Magnet Weight : 193 g (6.81 oz), Ceramic
Weight : 630 g (1 3/8 lbs)

FE-163

Price $14.64.
Plus Sales Tax $3.05.

Size : 160 mm (6 1/2 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_0) : 40 ~ 60 c/s
Frequency Range : f_0 ~ 20,000 c/s
Sensitivity : 98 dB
Power : 10 W max., 5 W nom.
Dimensions : 166 × 166 mm, 73.7 mm depth
Magnet Weight : 398 g (14.04 oz), Ceramic
Weight : 1,260 g (2 3/4 lbs)

Coaxial speakers

FX-201

with horn tweeter

Prices $23.88.
Plus Sales Tax $4.98.

Size : 200 mm (8 in.)
*Impedance : 16 Ω
Resonant Frequency (f_0) : 45 ~ 75 c/s
Frequency Range : f_0 ~ 18,000 c/s
Sensitivity : 101 dB
Power : 10 W max., 5 W nom.
Dimensions : 206 ϕmm, 137.5 mm depth
Magnet Weight : 240 g (8.46 oz)
Weight : 2,200 g (4 7/8 lbs)

FX-200 G2

with 2 1/2" tweeter

Price $21.60.
Plus Sales Tax $4.50.

Size : 200 mm (8 in.)
*Impedance : 16 Ω
Resonant Frequency (f_0) : 45 ~ 75 c/s
Frequency Range : f_0 ~ 18,000 c/s
Sensitivity : 101 dB
Power : 10 W max., 5 W nom.
Dimensions : 206 ϕmm, 140.7 mm depth
Magnet Weight : 234 g (8.21 oz)
Weight : 2,200 g (4 7/8 lbs)

2-way network

LC-100

Price $6.60.
Plus Sales Tax $1.38.

Crossover Freq.: 2,500 or 3,500 c/s
Impedance : 16 Ω
Attenuation : 6 dB/oct.
Dimensions : 63.1 ϕmm, 69 mm height
Weight : 280 g (9.88 oz)

2 or 3-way network

LC-300

Crossover Freq.: 350 or 700 c/s, 2,500 or 5,000 c/s
Impedance : 8 or 16 Ω
Attenuation : 6 dB/oct.
Dimensions : 83 H × 200 W × 134 mm D
Weight : 1,430 g (3 1/8 lbs)

Price $22.20.
Plus Sales Tax $4.63.

tweeter

FHT-1

Price $11.04.
Plus Sales Tax $2.30.

†Impedance : 16 Ω
Frequency Range : 2,500 ~ 16,000 c/s
Sensitivity : 100 dB
Power : 10 W max., 5 W nom.
Dimensions : 110 mm height, 95 mm depth
Weight : 330 g (11.75 oz)

(SOLE AGENT) ZEPHYR PRODUCTS PTY. LTD.
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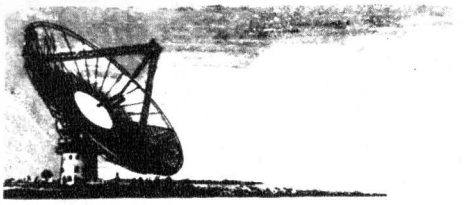


film of cadmium sulphide is "grown" in an evaporating plant. Heated cadmium sulphide at the bottom of the evaporating chamber is evaporated upwards and a stream of atoms is deposited on the glass slide within a heated chimney. To obtain the shape of film required, the atoms are evaporated through a mask cut to the required shape. The main problem up till now has been to deposit a perfect film on the slide — a problem which resolves largely as one of temperature control — but recently the Edinburgh team has perfected a process which overcomes this problem.

The DOFIC prooess is one of the more recent developments in the study of bulk semiconductor mechanisms, and as such is closely related to the techniques associated with the Gunn effect.

Colour TV standards converter

A significant technological breakthrough has been achieved by B. B.C. engineers with the invention of a system for converting colour television signals from the American 525-line, 60-field standards to the British and European 625-line, 50-field standards. The B.B.C. has been concentrating considerable effort on this problem in an attempt to devise a system which will allow direct exchange of programs between countries using either of these standards, particularly since the rather simpler systems previously used for black and white program conversions was not suitable for use with colour television. The Corporation was particularly keen to be in a position to make direct telecasts via satellite from the Olympic Games in Mexico next year. Now the early solution of the problem allows the B.B.C. to participate in trans-Atlantic exchange programs from the inception of its colour service.

The problem of differing line standards on black and white television had previously been solved in 1963, when the B.B.C. developed the first all-electronic converter, now in use throughout Europe. This allows programs originating on systems using the 625-line, 50-field standards to be converted for transmission over the B.B.C.-1 network, which uses 405-line, 50-field standards. The problem is greater when converting from American standards, because the differences are not only in the line standards but also in the field standards.

The optical methods of conversion previously used for 50 to 60 field conversion gave rise to picture degradation. While the degree of degradation was not regarded as serious for black and white television, it was of a quite unacceptable order for colour television. The new all-electronic converter does not suffer from the defects of the optical system.

SEACOM installation

World-wide subscriber-to-subscriber dialling became more of a possibility with the opening of the SEACOM cable link with South-East Asia. The equipment installed in Sydney to meet the requirements of the SEACOM cable is an extension of the Intercontinental Telephone Exchange supplied by the Plessey Telecommunications Group for the COMPAC cable in 1963.

The equipment allows trunk operators throughout Australia to dial direct via the cable to other parts of the world. Only one manual operation is involved, a single dialling by the international operator originating the call.

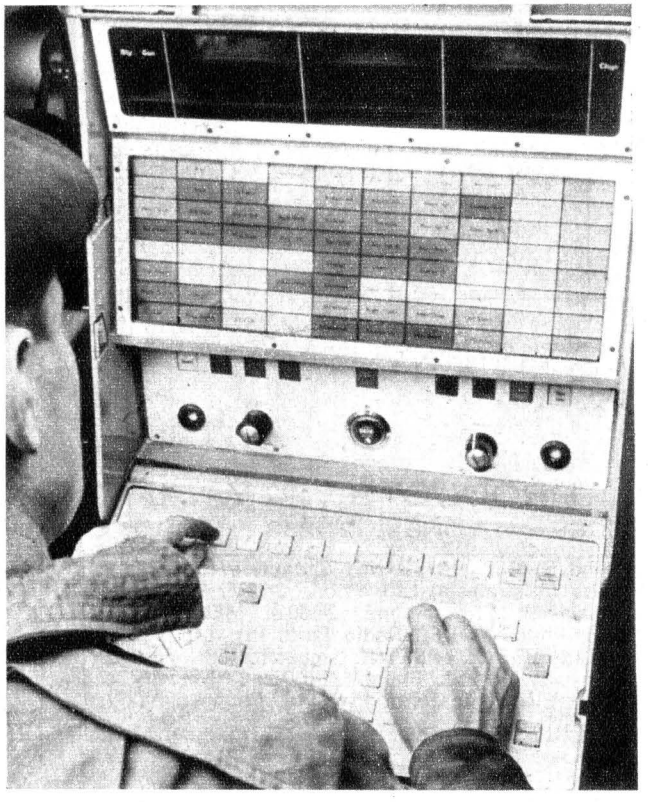
Post-graduate training

A post-graduate course in process control is to be arranged by the Sydney University Chemical Engineering Association, on behalf of the university's Chemical Engineering Department. This will be a full-time course of one week's duration, from August 28 to September 1, consisting of intensive study in process control, ranging from fundamentals of systems analysis to the latest techniques employing digital and analogue computers. The course will include lectures, demonstrations, and tutorials. An enrolment fee of $50 is payable, and a full set of lecture notes will be provided at no extra cost. Further details may be obtained from the Secretary, Department of Chemical Engineering, University of Sydney.

Marconidata for Czechoslovakia

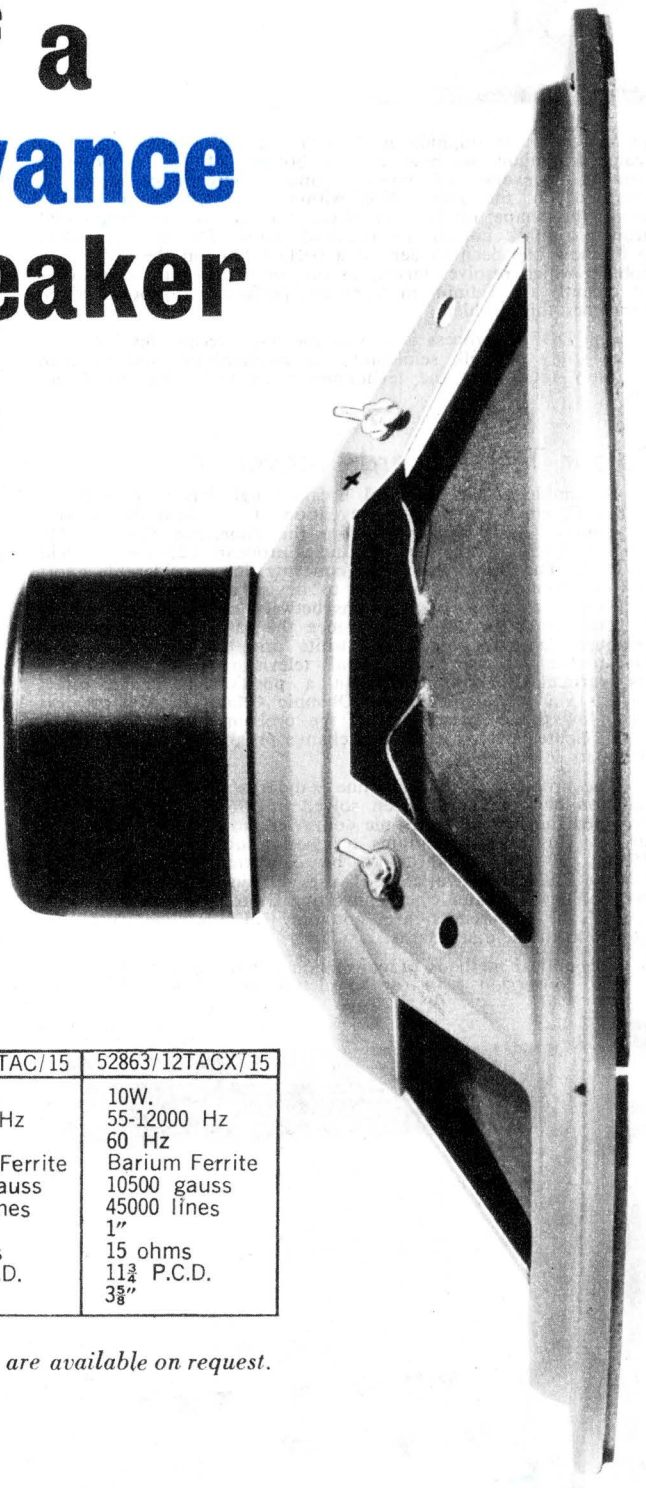
The Ministry of Transport (Railways Research Department) in Czechoslovakia, has bought a Marconidata type H6010 data transmission system from the Marconi Company, of England, to be used in the course of a complete evaluation of the use of the telephone network for data transmission. The type H6010 is a new addition to the Marconidata range of medium-speed data transmission equipment. By making a simple telephone call, an operator can transfer information from punched paper tape into a computer simply by pressing a button on the transmitting Marconidata terminal. No manual intervention is necessary at the receiving end.

Data can be transmitted at up to 50,000 characters per second, more than ten times faster than with a conventional telegraph or teleprinter circuit, and with a very high degree of protection from errors caused by noise and interference on the telephone curcuits. Less than one character in ten million will be transmitted incorrectly — roughly equivalent to printing the entire works of Shakespeare twice, with only one letter in error.



Seventy-six micro-electric computer systems, known as Field Artillery Computer Equipment (FACE), for front-line use by the Royal Artillery have been ordered from Elliot Space and Weapon Automation Ltd., England. The computer on which the system is based is in the left foreground of the view (above) inside a mobile command post in a tracked and armour-plated vehicle. Numerical data of target locations and meteorological information is put into the keyboard console of the equipment by an operator (left). The computer will calculate the range, bearing and angle of target, changes in weather data, the effect of gravity on shell flight, and correction for non-standard ammunition, all within the space of 12 seconds.

Profile of a great advance in 12″ speaker design



Three new additions to the wide MSP Hi-Flux range. These new 12″ models give magnificent transient response and are built for large power handling.

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Resonance	50 Hz	60 Hz	60 Hz
Magnet Material	Alnico V.	Barium Ferrite	Barium Ferrite
Flux Density	13,000 gauss	10500 gauss	10500 gauss
Total Flux	100,000 lines	45000 lines	45000 lines
V. C. Diameter	1¾″	1″	1″
Impedence	15 ohms	15 ohms	15 ohms
Mounting Hole Centres	11¾″ P.C.D.	11¾ P.C.D.	11¾ P.C.D.
Maximum Depth	4¾″	3⅝″	3⅝″

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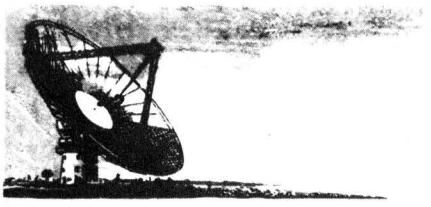


More computers for Uni.

A new large computer complex has been installed in the Basser Computing Department of the School of Physics, University of Sydney. It consists of an IBM 7040 coupled to an IBM 1401, and is the largest yet installed by the Department. It will be used to train undergraduates in computer applications. Post graduate students will be able to use the computer for research projects. The addition of these computers to those already available in the Basser Computing Department will greatly increase the number of student and research jobs the Department can handle each day.

The fast throughput of many different jobs on the IBM computers is largely due to the "IBSYS Monitor System" with which the two computers are equipped. This is a program, or a series of instructions, which controls a continuous stream of jobs in different computer languages to run on the machines without interruption.

The computer itself is a scientific/commercial machine, linked under control of the "Monitor" program. The central processing unit of 7040 is suitable mainly for fast handling of lengthy calculations; the 1401 on the other hand edits and co-ordinates feeding of alphabetic and numerical data into the system. Magnetic tapes can be handled by either processor.

Computer training for boys

An ambitious program of instruction, designed to provide every one of its boy students with a basic knowledge of computer operation and programming, has been successfully inaugurated at a high school in Connecticut, U.S.A. To initiate the program, the school has installed a PDP-8 scientific digital computer supplied by Digital Equipment Corporation, Maynard, Massachusetts (the U.S. principals of Digital Equipment Australia Pty. Ltd., 89 Berry Street, North Sydney).

For the initial training program, 34 students were selected, whose qualifications consisted of two years science and one year of algebra and geometry. A week was taken out of the normal teaching schedule and used to instruct the boys on computer fundamentals, programming techniques and Fortran computer language. At the end of this time, the students were given a qualifying assignment. This consisted of writing a program to find the values of X in the quadratic equation

$$AX^2 + BX + C = 0$$

for all values of A, B and C. Within two weeks, 28 of the 34 students had a working program.

Using the approach developed on the first group, over 90 per cent of the school was given a short computer course, adjusted to the level of mathematical maturity of each group of students. Assignments, to be carried out on the computer, were given to all the science and mathematics classes. These assignments were problems that the teachers would normally have hesitated to use, because of the amount of time required.

With the program successfully initiated, boys are now working on programs dealing with topics such as electronic circuit analysis; a new triple precision floating point arithmetic package; and refraction of light in the atmosphere. Some of the boys are programming using MACRO-8, the PDP-8's symbolic assembly language. They are also using a desk-calculator simulator program called "Calculator" to do their homework and laboratory calculations.

Portable security system

Securiton Ltd., of Worcester Park, England, has added a new solid state portable alarm to its range of security systems. The system, designated "Bleep," comprises a lightweight transmitter housed in an unbreakable case and a receiver which accepts a coded message from the transmitter over a special radio link. The signal is released by a pushbutton switch on the transmitter. Upon receipt of the signal from the transmitter, the receiver actuates warning signals such as bells or a telephone call to police. Any number of "Bleep" transmitters can operate in close proximity since each uses a different coded frequency signal.

The transmitter is housed in a pocket sized case (2¼in x 3¼in x 1in) with the aerial integrated in the case. It operates on a mercury cell which will give power under normal use for more than one year. The receiver is powered by an external supply which normally comes from the batteries of a security control unit. The integral coding system protects completely against receiving a signal from sources other than its own transmitter, and it is impervious to any local interference such as electrical discharge, motors, etc.

Semiconductor patents

Patents covering two manufacturing techniques that counteract surface and bulk defects in semiconductor devices have been awarded to Motorola Inc. based on research work at the company's Semiconductor Products Division here.

Patent No. 3,302,076 "Semiconductor Device with Passivated Junction," relates to an improved design for passivated diodes and transistors whereby the electrode configuration for contacting the various conductivity regions of such devices acts to improve their surface states. It covers an invention commonly referred to as "field relief electrode" or "equipotential ring" technology.

This was followed by two patents on the annular process for manufacturing semiconductors, bringing to 54 the total number of semiconductor patents issued to Motorola within the past two years.

The issuance of these recent patents on the annular process and field relief electrodes is noteworthy because the two technologies are often merged for complementary effects. Field relief electrode and annular developments serve complementary roles in device manufacture by controlling surface and bulk defects.

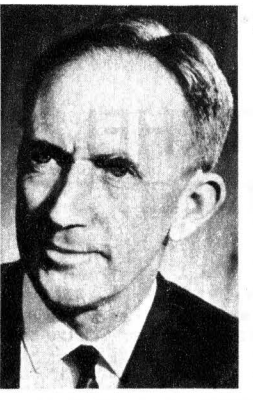
Field relief electrodes are used broadly in the manufacture of semiconductor devices that have been manufactured with a protective, passivating oxide film over critical surfaces. Without the electrodes, unwanted surface states can have an unfavourable effect on the electrical characteristics of the devices particularly if they are not annular in structure.

Contamination and other effects of passivated surfaces can alter the resistivity and nature of the semiconductor material regions near the oxide-semiconductor interface, especially adjacent to the junctions. The use of field relief electrodes helps to eliminate this problem and consequently improves product performance and reliability.

Major Mexican orders for telecommunications equipment have been won by Standard Telephones and Cables Pty. Ltd., against worldwide competition. The microwave radio-link equipment has been bought by Telephonos de Mexico principally to accommodate the increased tourist traffic and also as a preparation for next year's Olympic Games. It is the second big Mexican order awarded to STC. Last year, the company won an order for radio-link equipment valued at over $300,000. The dotted lines on this map of Mexico indicate the routes of telephone links covered by orders received by STC. The latest contract is for the Mexico City-Acapulco and Monterrey-Nuevo Laredo links.

NEW PRESIDENT FOR I.R.E.E.

Professor R. M. Huey has been elected President of the Institution of Radio and Electronics Engineers, in succession to Mr A. de Courcy Browne. Professor Huey is Associate Professor of Electrical Engineering at the University of N.S.W. and has recently been appointed to a biennial vacancy on the council of the University as representative of the Faculty of Engineering. He has been a senior member of the I.R.E.E. since 1963 and has served variously on the Publications, Qualifications and Education Boards of the Council. He is also a member of the National Committee for Scientific Radio of the Australian Academy of Science, and is Australian correspondent for Commission VI of the International Union for Scientific Radio.



Call for papers

The next triennial congress of the International Federation for Information Processing — IFIP Congress 68—will be held in Edinburgh, Scotland, from August 5 to 10, 1968. In addition to invited papers reviewing various aspects of computing, a large part of the program will be devoted to submitted papers. These will cover computer applications, hardware, software, and mathematics. An appeal for papers has been made and full details of the procedure for submitting papers can be obtained from IFIP Congress Office, 23 Dorset Square, London N.W.1, England.

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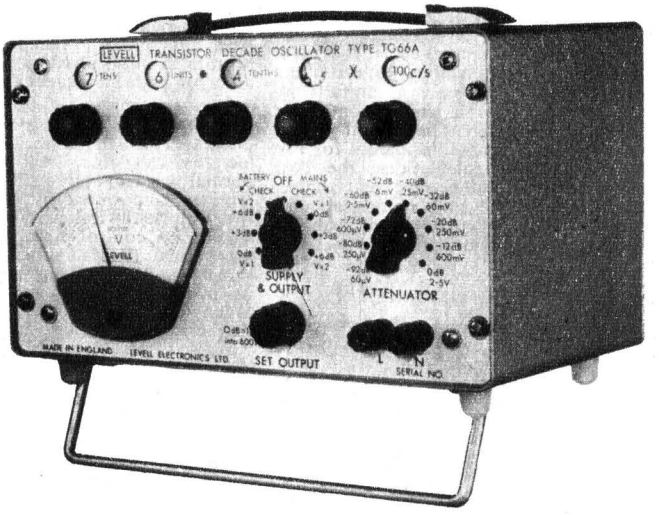

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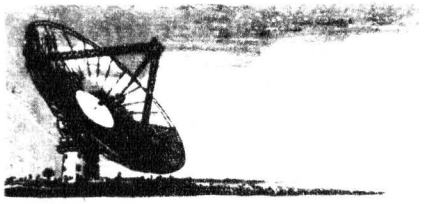


Colour TV course

The Division of Post-Graduate Studies in the University of New South Wales will present a series of ten radio lectures designed to give an introduction to the principles and techniques of colour television. The lectures will be broadcast weekly over Radio University VL2UV, Newcastle, commencing in August, 1967. The course covers the fundamentals of the NTSC, SECAM and PAL systems, the principles of colorimetry and the chromaticity diagram, the nature of chrominance signals, coding transmission. The course will also deal with colour cameras, colour receivers, and testing and set-up procedures for colour systems.

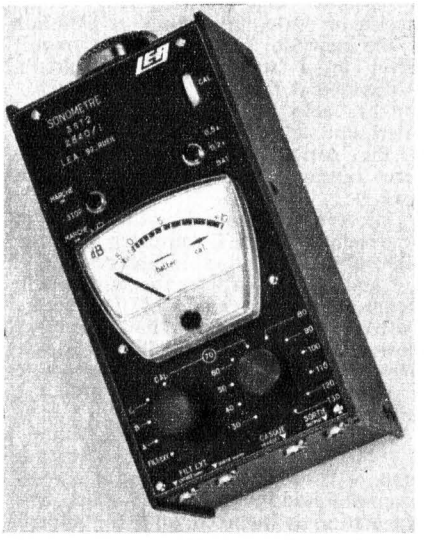
The fee for the course is $6, which may be tax deductible. This covers the supply of the printed notes, which are essential for an understanding of the lectures. Closing day for enrolments is 14th July, 1967.

Further information on this course and other Radio University programs can be obtained from Radio University, P.O. Box 1, Kensington, Sydney.

Unique recorder

Inexpensive, highly precise X-Y recorders using 8½ x 11in chart paper, held in place by permanent magnetism, are now available from the Varian Recorder Division, 611 Hansen Way, Palo Alto, California 94303. Designated the Series F-100, these rugged new table-top recorders are highly accurate —0.25 per cent of full scale — and have greater range sensitivity (100 microvolts/inch) than earlier models. Slewing speed (60Hz) is 15in/second, and repeatability is 0.28 per cent of full scale.

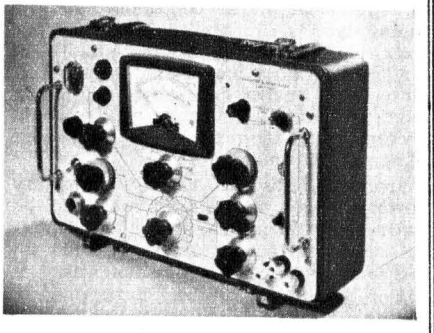
Unique with this recorder is the method of holding down the chart paper. The platen is a magnet-impregnated hard rubber pad, and the paper is printed on one side with a magnetic ink pattern. Attraction between the two firmly maintains paper alignment and eliminates the need for electrostatic or vacuum hold-down devices commonly used on X-Y recorders. The paper position on the platen can be easily adjusted. No electronics are used for paper hold-down; thus, it is "fail-safe," requires no power, and is always "on."



This compact sound level meter, manufactured by Laboratoire Electro-Acoustique of France, is designed to simulate an average human ear and to provide objective measurements of sound or complex noise levels within a range extending from close to the audibility threshold to above the pain threshold.

First BC station in Qatar

Qatar, one of the wealthy oil States in the Arabian Gulf, is to establish its first broadcasting station. The project was put to international tender and won by The Marconi Company, who have already started to supply the equipment. A 100KW short-wave transmitter will be used to provide coverage over a 1,200 miles radius and will be supplemented by a 10KW medium wave transmitter for local broadcasting. Both transmitters, broadcasting identical programs, will be installed in a station a few miles outside Doha, the capital of Qatar, and will be connected to a studio in Doha itself. Marconi's anticipate that they will have the project completed in time for transmissions to begin early in 1968.



A new instrument, Type TT537, manufactured by Avo Ltd., Dover, England, determines the characteristics of transistors and diodes. It measures transistor hfe up to 1500 at a frequency of 1KHz. Also leakage current, starting at 1uA, for PNP and NPN, low and medium power, germanium and silicon transistors. The collector voltage can be varied continuously up to 12V. Collector current is measured in 10 ranges from 1uA to 1A. The reverse characteristic of diodes can be determined up to 1000V, the current being automatically limited. The forward characteristic is measured at 1.5 or 5V with a maximum current of 500mA.

Computerised water supply

For the past three years Britain's Water Research Association has been solving water distribution network problems for member authorities by using a British Aircraft Corporation Analogue Computer installed in the Association's physics department. The Birmingham City Council's Water Department have now taken a lead by placing an order for one of these computers for use in the first regional centre, at which the distribution networks of Birmingham and neighbouring authorities will be studied.

The BAC Analogue Computer provides an electronic "carbon copy" simulation of the actual water network, in which flow and pressures are read out in the units used by the Distribution Engineer. In this way, the experience of the engineers can be applied directly to the "carbon copy" model without the need for translation into special programs or "computer language."

This method of computation is rapidly gaining favour and water engineers from many overseas authorities are now going to the U.K. to study their networks on the BAC Water Network Analogue. ■

Factors in the design of an FET Voltmeter

At first sight, design seems likely to involve little more than modification of the usual VTVM circuit. But it isn't that simple . . .

by Jamieson Rowe

Over the years the familiar "vacuum-tube voltmeter" or VTVM has become firmly established in electronics workshop and laboratory situations as the preferred instrument for making circuit voltage measurements. With an input impedance usually of the order of 10-megohms shunted by a few picofarads it causes little if any disturbance to the circuit under test, and is thus able to make valid and unambiguous measurements in places where other instruments would either upset circuit operation entirely or at least produce dubious readings.

In the majority of workshop and laboratory situations the usual VTVM has few limitations; however it has two characteristics which make it somewhat unsuited for use in "field" situations. The first of these is that it is almost invariably a mains-powered instrument, and cannot easily be taken to places remote from the power mains. The second characteristic is that it usually employs the thermionic valves in a DC amplifier circuit which commonly takes of the order of 5-10 minutes to stabilise after switch-on.

A battery-powered VTVM would probably be feasible, but would tend to be somewhat more complex than the mains type if reliability and accuracy were to be maintained. It would also tend to be rather inefficient, in common with other thermionic valve equipment operated from batteries, and would accordingly require quite frequent battery replacement.

In any case, the use of a battery power supply would not obviate the warm-up problem, and this alone would detract from the usefulness of such an instrument in many "field" situations.

For some time now it has been possible to construct a "solid state" equivalent of the VTVM using junction transistors. However such instruments again tend to be rather complex if reliability and accuracy are to be maintained, both because junction transistors are inherently low input impedance devices and also because there are problems with leakage currents and their temperature dependence.

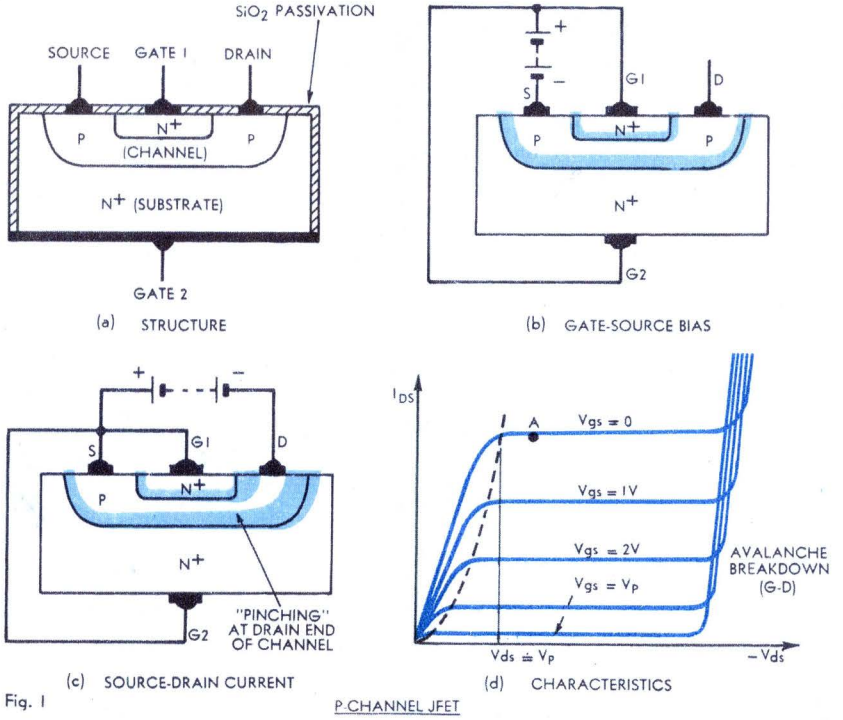


Fig. 1

The structure of a double diffused P-channel JFET, together with diagrams used to explain its operation and a graph of the drain voltage-drain current characteristics.

It is true that there are fewer problems in this regard with silicon transistors than with the germanium variety, and that with suitably chosen devices it is possible to produce quite a satisfactory design. However, the complexity and cost tend to be rather high, so that the appeal of such an instrument is largely in terms of the design exercise.

Whereas germanium and silicon junction transistors are inherently rather unsuitable for use in this type of circuit, the recently developed field-effect transistor or "FET" is in theory quite well suited. It is a voltage-controlled device, in contrast with the current-controlled junction transistor and, in addition, it has the very high inherent input resistance of a reverse-biased P-N junction rather than the low resistance of a forward-biased junction. (We are talking here of the junction FET or "JFET" rather than the insulated-gate IGFET or the metal-oxide-semi conductor MOSFET, but these have even higher input resistance than the JFET.)

In principle the FET seems so well suited for use in an electronic voltmeter that, at first sight, one is tempted to assume that development would consist of little more than substitution of the new devices for the thermionic valves in a standard VTVM circuit. Evidence that this is a common assumption has been provided by a number of letters and telephone calls from readers in the period since economy JFETs were released here some six months ago.

Unfortunately there is rather more to the design of an FET voltmeter than one might think from an initial consideration and, in this article, the author will attempt to explain some of the factors involved. It is hoped that this will allow readers to understand why, as yet, **Electronics Australia** has not been able to publish an economically practical design.

While the discussion will be mainly in general terms, some practical circuit details will be given. However, it should be emphasised at the outset that this information is intended only for experiment by those interested and should not be taken as the basis for a regular constructional project.

It will probably be worthwhile to begin with a brief description of the JFET and its operation, both as an introduction to the device for those yet unacquainted with it and as a recapitulation for those not in this position. Readers who find the description given here too cursory are referred to a more

detailed treatment which was published in the February 1967 issue (pp. 85-87).

The operation of the JFET is quite different from that of the normal junction transistor. Basically it involves the control or modulation of the conductance of a relatively narrow strip of semiconductor material called the **channel** by a transverse electric field associated with an adjacent electrode called the **gate.**

Figure 1(a) shows the basic structure of a P-channel double diffused JFET, which is the type of device currently available at low cost. As may be seen it consists of a lightly doped (therefore low conductivity) P-type channel with heavily doped (and therefore high conductivity) N-type gate regions either side of the narrow section. The ends of the channel are normally called the "source" and "drain," while the two N-type regions are normally tied together and simply called the "gate."

In general terms the device operation depends upon the gate-channel P-N junctions being reverse-biased so that depletion regions extend into the lower conductivity channel and, by exclusion, control the portion of the channel available to pass current between the source and gate. More specifically, there are two independent but complementary phenomena involved, and these are illustrated by the diagrams of figures 1(b) and 1(c).

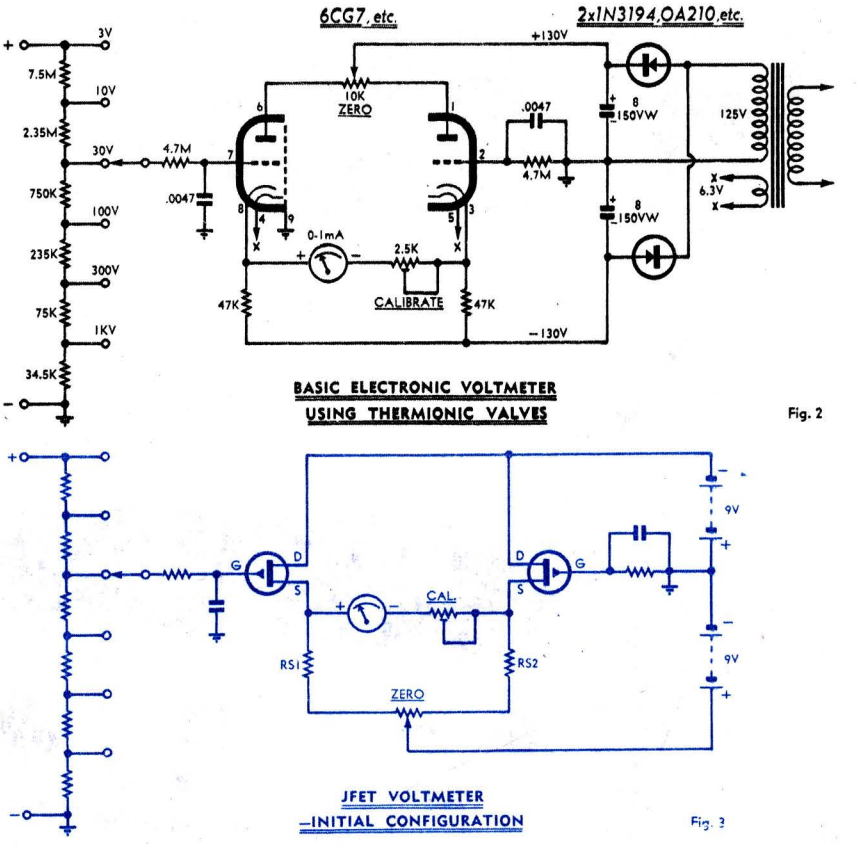
If a fixed external bias is applied between gate and channel as in (b), the depletion regions extend evenly throughout the channel. In contrast, if the gate is tied externally to the source and source-drain current allowed to flow as in (c), the ohmic voltage drop set up in the channel produces a progressive **internal** reverse-biasing of the junctions, causing the depletion regions to extend unevenly and "pinch" the narrow channel at the drain end.

In normal operation both mechanisms operate to produce a family of Ids-Vds curves, as shown in figure 1(d). For any given external gate-source bias Vgs the drain current first increases rapidly, then reaches a "knee" after which it increases only with substantial increase in Vds.

The "knee" of each curve corresponds to an equilibrium between the channel current flowing and the "pinching" of the channel which tends to reduce current. As the fixed bias Vgs is increased, the "knee" occurs at lower and lower drain voltages and currents, as shown by the dashed parabolic curve. Theory shows that this curve corresponds to the locus of points where the **drain-gate voltage Vdg** is equal to a value Vp, termed the "pinch-off" voltage. Thus when there is zero external gate bias (Vgs = 0) the "knee" occurs at Vds = Vp; while if the external gate bias is raised to equal Vp (Vgs = Vp), the device is effectively **cut off** because the pinch-off equilibrium is present even before drain current flows.

The region of the characteristic curves to the left of the dashed parabola is normally called the region of "triode" operation, while that to the right is called the "pentode" region. In both cases the terms used draw attention to similarities between the section of the characteristics concerned and those of the appropriate thermionic valve type.

The JFET is normally operated in the "pentode" region as it is here that the device is capable of the highest order of linear amplification.



At the top is the basic circuit of a modern electronic voltmeter using thermionic valves. Beneath it is a basic JFET voltmeter circuit derived from the valve circuit, used as a starting point for the discussion.

Having briefly introduced the JFET and its operation, let us now consider how the device may be used in an electronic voltmeter.

Figure 2 shows the basic DC voltage measuring circuit of a modern thermionic valve voltmeter. As may be seen it consists essentially of a pair of cathode followers having the meter connected between their cathodes. The follower on the left is used as an impedance transformer coupling the input signal to the meter, while the follower on the right is used to maintain the negative side of the meter at a voltage level equal to that of the left-hand cathode with zero input. The right-hand follower may be regarded as a voltage divider whose division ratio and temperature coefficient are closely matched to those of the input follower.

The 10K pot in the plate circuit is used to adjust for exact balance between the two followers. The action of the pot is thus that of a "zero" adjustment.

As the input cathode follower has an extremely high input resistance a simple voltage divider may be used to perform range multiplication, the total divider resistance being set at about 11M so that the loading effect of the instrument will be slight.

As a small amount of grid current is inevitable even with modern valves it is necessary to maintain an approximate correspondence between the resistance in the grid circuits of the two cathode followers if the balance between the two is to be maintained despite range switching. This is the purpose of the 4.7M resistors in each grid circuit.

The power supply to the followers is arranged so that, for zero input, both grids are at a potential midway between the positive and negative supply rails. This ensures that the quiescent voltage drop of the valves is approximately equal to that of the cathode load resistors, a condition which tends to give the greatest available dynamic range and hence the highest linearity.

From a preliminary appraisal of the JFET and using the design philosophy behind the valve circuit as a guide, one is led fairly naturally to propose the circuit of figure 3 as the starting point for a JFET version.

As may be seen this involves little more that the substitution of a pair of JFETs for the original double triode, and twin 9V batteries for the original centre-tapped power supply. The circuit now becomes a twin "source-follower."

The only other change is that the zero balance control has been placed in the source circuit rather than in the drain circuit. The reason for this is that from a consideration of the pentode-like JFET characteristics one would expect that a control in the drain circuit would have only a second-order effect upon the JFET currents. In contrast a control in the source circuit seems likely to be somewhat more effective, in that it will give differential control over the self-bias developed by the devices in their source resistors.

Note that series gate resistors have been shown, corresponding to the resistors used in the valve circuit to maintain approximate zero balance despite gas current. The reason for retaining these resistors in the JFET circuit is that these devices have an effective equivalent to

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gas current in **Igss**, the leakage current of the gate-channel junctions.

Probably the most effective way of showing up any "first-order" problems which may be involved in a circuit is to attempt to set its quiescent operating conditions. Accordingly, having accepted the circuit of figure 3 as a likely starting point, our most profitable next move will be to consult the JFET data sheets with the intention of arriving at the appropriate circuit constants.

Reference to the data sheets of currently available devices reveals almost immediately an important complication regarding their circuit behaviour and its prediction. The complication is that JFET parameters, like those of other semiconductor devices, are subject to appreciable **production spreads.**

It is probably true to say that currently available JFETs are, as a class, subject to somewhat wider spreads than other commonly used devices. Whether this is true or not, however, it is inevitably the case that the JFETs with the widest parameter spreads are the very devices which originally prompted the present article—the recently released "economy" devices.

A good idea of the extent of the spreads associated with economy JFETs may be gained by reference to the 2N4360 device, which we have used in a number of recent **Electronics Australia** projects. From an economy viewpoint this device is particularly attractive in view of its unit cost of $1.05 in small quantities.

A parameter which plays a major part in determining the DC circuit behaviour of a JFET is **Idss**, the drain-source current with **zero** gate-source bias and a specified drain-source supply voltage. On the curve of figure 1(d) Idss corresponds to the drain current at a point A on the Vgs = 0 curve; as may be seen it effectively determines the absolute scaling of the vertical (Id) axis.

With the 2N4360 device this parameter has a spread covering a full decade in current values — the maximum specified value is 3mA, while the maximum is 30mA.

The second main DC parameter of the JFET is **Vp**, the nominal pinch-off voltage. This is defined in a number of ways, the simplest being that it is the reverse gate-source voltage necessary at a specified drain-source supply voltage to reduce the drain-source current to a very low (effectively zero) value. Because of the control characteristic of the JFET this parameter is closely related to the transconductance of the device, as will be shown shortly.

The spread in Vp for the 2N4360 device is not fully specified by the manufacturer, who quotes only a nominal value of 5.5V and a maximum of 10V. However from a consideration of the transconductance figures given one can make a fair estimate of the minimum Vp, and this works out to be a little below 1V. Hence parameter Vp also has something like a full decade of spread variation.

Probably the most immediate implication of the wide spread in JFET parameters is that the family of Ids-Vds curves of figure 1 (d) becomes of little use for design, or at least for the purpose of setting up DC operating conditions. Because of the wide spread in both Idss and Vp, there will be virtually a whole "family of families" describing the possible Ids-Vds characteristics of the device; and because Idss and Vp are independent within certain limits, the number of "member families" will be extremely large.

The result is that we are forced to seek a more concise method of presenting the JFET behaviour, and one which is capable of showing the performance of all individual devices within the spread limits. A characteristic which satisfies these requirements is the Ids-Vgs "transfer" characteristic, which corresponds to the Ip-Vg curve of a thermionic valve.

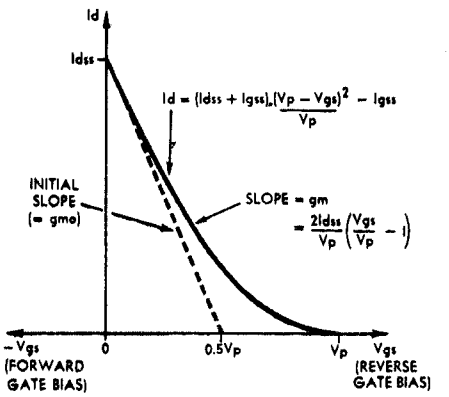
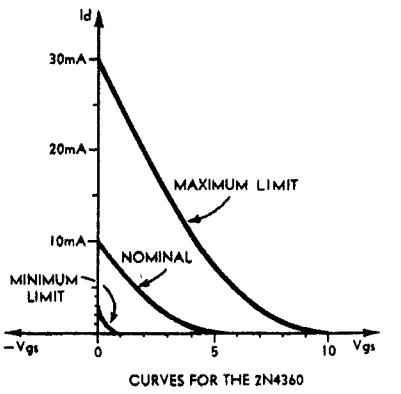


Fig. 4 (a)



(b)

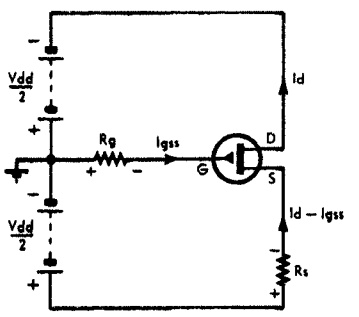
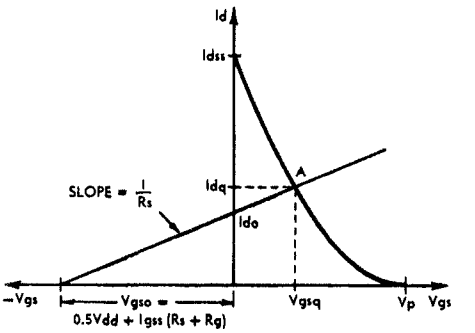


Fig. 5 (a)



(b)

More specifically, as we are usually only interested in operating the JFET in the pentode region, we are accordingly interested only in its Ids-Vgs characteristic for this region. And it so happens that within this region of operation the transfer characteristics of the JFET can be deduced fairly easily from the data provided by the manufacturer.

Most JFETs currently available, including the 2N4360, are fabricated by a diffusion process. For such devices the transfer characteristic very closely approximates a parabola, whose equation is

$$Ids = (Idss + Igss).\left(\frac{Vp - Vgs}{Vp}\right)^2 - Igss \quad \ldots(1)$$

Substitution of Vgs=0 into this equation shows that the characteristic crosses the vertical Id axis at a height corresponding to Idss. Similarly the point where it asymptotically meets the horizontal axis is found by substituting Ids=0, and this turns out to be where Vgs=Vp. Between these two points Ids varies closely as the square of the difference between Vgs and Vp.

The instantaneous slope of the transfer characteristic is a measure of the relation between Ids and Vgs — i.e., it represents the transconductance. As the slope is greatest at the point where Ids=Idss, this shows that the JFET has highest gain when zero bias is applied.

It is this maximum value for transconductance (gm) which is usually quoted by the manufacturer, either as such or as the closely equivalent parameter Yfs — the forward **transadmittance** at a specified signal frequency (usually 1KHz).

If we substitute Idss for Id in equation (1) and differentiate we get an expression representing the **maximum** transconductance. This turns out to be approximately

$$gmo = \frac{-2.Idss}{Vp} \quad \ldots(2)$$

From this it can be seen how closely the performance of the JFET is dependent upon the two parameters Idss and Vp.

Put into words, the implication of expression (2) is that the tangent to the transfer characteristic at Id=Idss intersects the horizontal axis at Vp/2. This is indicated by the dashed line in figure 4(a), which also shows the other general properties of the JFET characteristics.

By rearranging expression (2) we can use it to find the Vp of a device, given its Idss and its maximum gm. Hence in the case of the 2N4360, for which no minimum limit is quoted for Vp, we can obtain a close estimate by dividing twice the quoted **minimum** value of Idss (3mA) by the quoted **maximum** value of gmo (8mA/V). This gives a lower limit for Vp of 0.75V.

Similarly if the manufacturer had not supplied a maximum limit value for Vp we could obtain a close estimate again, this time by dividing twice the maximum value of Idss (30mA) by the quoted minimum value of gmo (2mA/V). This would give a maximum

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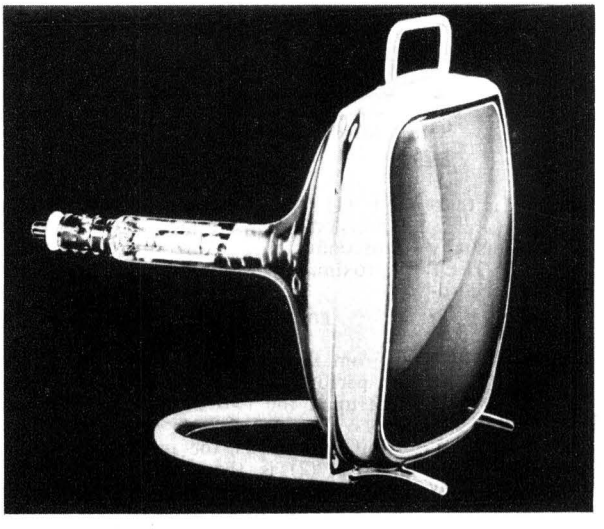

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Vp of 30V whereas, in fact, the maximum Vp is quoted as 10V — which suggests that devices which combine a high Idss with a low gain are rejected from the production yield.

We have now reached a point where we can draw transfer curves for a device representing both its nominal behaviour and the limits of spread variation. This information has been drawn for the 2N4360 in figure 4(b).

The performance of a nominal or "bogie" device is represented by the middle curve, terminating at Idss= 10mA and Vp = 5.5V and with a gmo of approximately 4mA/V. The two remaining curves represent the limits of spread variation about this nominal curve, which variation may be seen to be quite appreciable.

To see how the transfer characteristic is used to determine the operating point of the source followers in our tentative JFET voltmeter circuit, consider now the circuit of figure 5(a). This represents the basic DC circuit of each follower for the zero input situation.

From this circuit it may be seen that there are three components of bias voltage applied to the JFET gate-source electrodes. These comprise the fixed forward bias Vdd/2, a small additional forward bias produced by the gate leakage current Igss flowing in gate resistor Rg, and finally the reverse bias set up across source resistor Rs as a result of the source current (Id—Igss).

Because the third of these components amounts to negative feedback, the bias applied to the JFET by the circuit will not be independent of the current drawn by the device. Hence we must take both the parameters of the JFET and the constants of the circuit **simultaneously** into account in order to determine the quiescent operating conditions.

In effect, what this means is that to find the JFET operating point we must solve, by one means or another, two simultaneous equations: one describing the relationship between Vgs and Id from the "point of view" of the JFET, and the other describing the relationship between the same quantities from the "point of view" of the circuit. Fairly obviously, the quiescent operating conditions will be those (presumably unique) conditions which satisfy both these "points of view" at once.

The second or "circuit" relationship can be found fairly easily from a DC analysis of figure 5(a). From this we first get an expression showing the three components of bias voltage Vgs:

$$Vgs=(Id-Igss).Rs-Igss.Rg-0.5Vdd \quad \ldots(3)$$

Rearranging this, we then arrive at an expression showing drain current Id as a function of Vgs and the circuit constants:

$$Id=\frac{Vgs+Igss\ (Rs+Rg)\ +0.5Vdd}{Rs} \quad \ldots(4)$$

We have already noted the first, or "device" relationship between Id and Vgs; it is the device transfer characteristic symbolised by expression (1). However, it must be remembered that this expression applies only to the pentode region of JFET operation. Hence before we can use the expression we must check that the **gate-drain voltage** applied to the device exceeds the value Vp which marks the boundary between triode and pentode operation.

In the present circuit this will be approximately true providing Vdd/2 is equal to or greater than Vp for the device concerned.

Although one might expect that we could now go ahead and simply solve expressions (1) and (4), this is not the case. As a result of the spread in device parameters we have in these expressions a larger number of variables than the two which we seek.

If there were no spread, the terms Idss, Igss and Vp would be **constants** for the particular device type concerned; however, because of spread these terms are, in fact, **variables.** All we know from the manufacturer's data is the nominal value and maximum and minimum limit values of each.

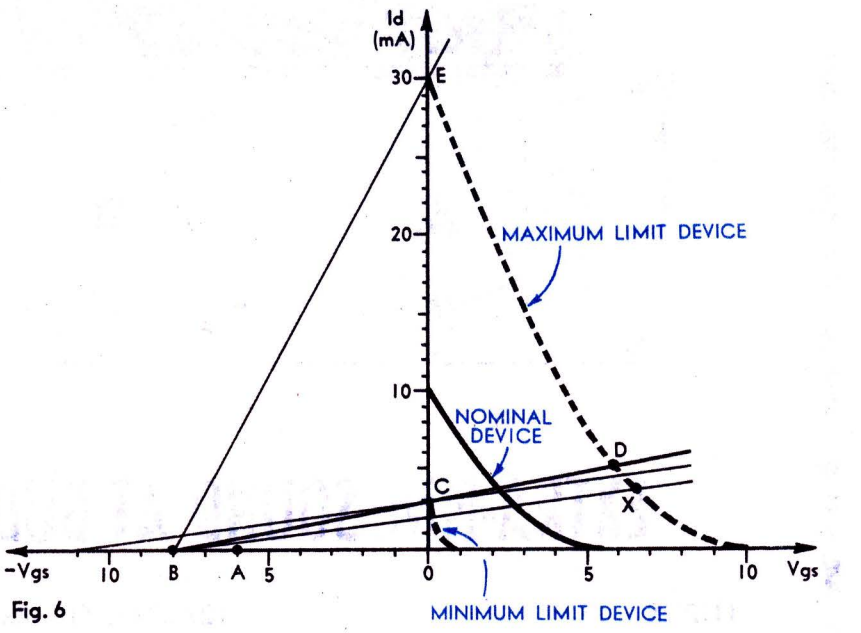

Fig. 6

The problem of remaining within the region of pentode operation also returns, because with some devices the criterion that Vdd/2 be equal to or greater than Vp may not be satisfied. To satisfy this requirement for all devices of the given type it may therefore be necessary to reduce the fixed gate bias below Vdd/2.

One way of overcoming the main spread problem is to solve (1) and (4) three times, substituting for Idss, Igss and Vp in the first case the nominal device parameters, and in the second and third cases those limits of these parameters which by "educated inspection" will result in the limits of operating point variation.

As the circuit being considered is a relatively simple one, expressions (1) and (4) are sufficiently straightforward to allow the three solutions to be found in time-honoured "manual" fashion. Even so, the results will generally be somewhat more reliable and more accurate if the calculation can be performed using a digital computer.

With JFET circuits significantly more complex than this simple circuit, for this "direct calculation" determination of quiescent operating conditions to be practical at all it becomes virtually essential to use a digital computer to perform the calculations.

Use of a computer has the additional advantage that the machine can be programmed to actually **find** the limits of operating point variation rather than simply calculate the expected limits. With more complex JFET circuits this can be important because for such circuits expression (4) will become quite large and unwieldy, and it may become quite difficult to make predictions of the limits by "educated inspection."

With a relatively simple circuit of the type with which we are at present concerned there exists an alternative method to the "direct calculation" approach, and the alternative method is not only more convenient but in certain respects more informative. It is a graphical method of solution, and is illustrated in figure 5 (b).

The rationale of this method is as follows: Because the gate current Igss is the reverse-bias saturation-leakage current of the gate-channel P-N junctions, it is essentially independent of gate-channel voltage. As a result, two of the three components of the JFET gate-source bias voltage may be regarded as constant, leaving only the feedback component as a variable.

Both the fixed bias components constitute forward bias, as they tend to make the JFET gate negative with respect to the source. Hence from expression (3) we can theorise that prior to the flow of channel current in the device, there will be a forward bias applied between gate and source whose magnitude will be given by

$$Vgso=0.5Vdd+Igss\ .\ (Rg+Rs) \quad \ldots(5)$$

In fact, channel current does flow, and, as a result, the third or "feedback" bias component appears as a voltage drop across Rs. This component amounts to **reverse bias,** and will have a magnitude of **Id.Rs.**

Using this information we can draw on the same axes as our JFET transfer characteristic a **"bias line"** representing the relationship between Id and Vgs from the circuit viewpoint. The line will intersect the horizontal axis (where Id=0) at a forward bias given by **Vgso** in (5), and will have a slope of **1/Rs** to describe the way in which Id must increase in order to produce the reverse biasing feedback voltage.

For convenience in drawing the bias line, the point where it intersects the

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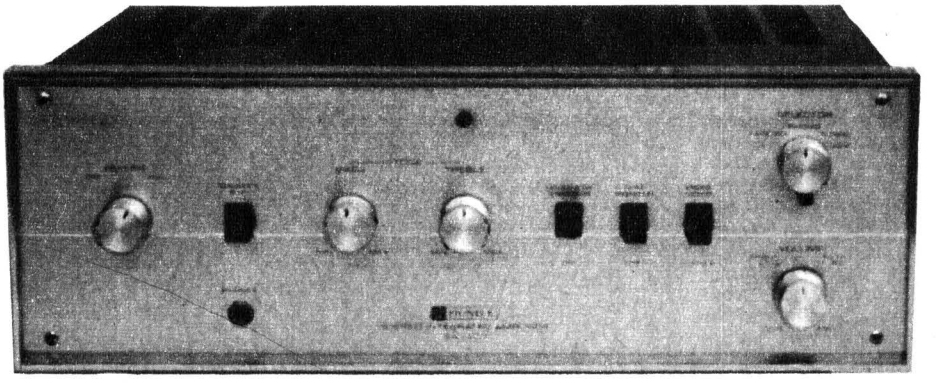

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vertical axis (Vgs=0) can be found. This will be at a current **Ido** given by

$$Ido = \frac{0.5Vdd + Igss \,.\, (Rs+Rg)}{Rs} \quad \ldots(6)$$

It should be apparent that in drawing the bias line on the same axes as the JFET transfer characteristic we produce a composite diagram which shows both the "device" and "circuit" relationships between Id and Vgs. Hence it follows that in general the intersection of the bias line and the transfer characteristic represents the quiescent operating point of the circuit, as this point is unique in satisfying simultaneously the device and circuit relationships.

Thus in figure 5(b) if we have a particular device whose transfer characteristic is as shown by the dashed curve, we may in general conclude that its quiescent operating point will be "A," with a channel current of Idq and a gate-source voltage of Vgsq.

As with the calculation approach there is one important qualification to this conclusion. This is that the JFET characteristic which we are using applies only to the pentode region of operation. Hence it is important to check that the device is actually operating in this region before it can safely be concluded that A is in fact the operating point.

It was noted earlier that for operation in the pentode region the drain-gate voltage of the device must be either equal to or greater than its Vp, and that in the present circuit this is satisfied approximately if Vdd/2 exceeds Vp. More accurately the criterion is given by

$$Vdd - Vgso > Vp \quad \ldots(7)$$

In other words, Vdd should be greater than (Vgso + Vp), and this can be ascertained quite easily from the horizontal axis of the diagram.

For the purpose of introducing the graphical method of solution we have thus far ignored the spread variation in device parameters. In fact such variations will mean that in place of the single device transfer characteristic of figure 5(b) we must consider a whole range of possible characteristics, of which only the limiting cases are defined.

Hence for a practical circuit using a device such as the 2N4360 considered earlier the diagram will in fact resemble figure 6. As in figure 4(b) there are now three curves representing the nominal, maximum and minimum limiting values for the transfer characteristic of the given device type.

In attempting to use this diagram to design a practical JFET voltmeter circuit the first step is to check that all devices will operate in the pentode region of their characteristics. This means in effect that expression (7) must be satified even for those devices with the maximum Vp (i.e., 10mA for the 2N4360).

Both from this point of view and from that of linearity it is desirable to use as high a Vdd as possible. With the type of circuit being considered, however, there is an upper limit on Vdd imposed by the device voltage ratings. For the 2N4360 the ratings dictate that Vdd cannot with safety be increased above 20V.

Even if Vdd were made 20V, the fixed forward bias component Vdd/2 alone would only just permit pentode operation of all devices. Thus when the additional bias due to Igss flowing through Rg is taken into account, together with the fact that we originally proposed a centre-taped 18V supply, it can be seen that a centre-tapped supply is just not feasible if the circuit is to operate correctly with all devices.

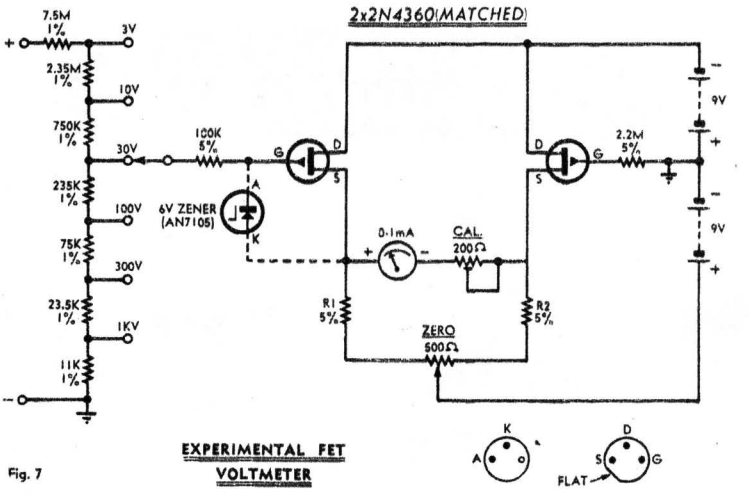


Fig. 7

Note that whereas in some applications it would be permissible to ignore the Igss-Rg component of forward bias, with an electronic voltmeter design this cannot be done. The gate resistor Rg will normally be a direct function of the voltmeter input resistance, and will thus tend to be quite high; not only this but as an instrument the circuit would normally be expected to operate reliably up to moderately high temperatures, where Igss will tend to become appreciable.

In the light of the foregoing it would seem that the most practical supply arrangement would likely be three 6V batteries in series, with the lower junction earthed. This would give a Vdd of 18V and a forward gate bias of 6V, figures which would probably ensure pentode operation of all 2N4360 devices up to about 50 degrees C. and with an input divider arranged to give an equivalent Rg of about 2.5M.

Once Vdd and the fixed forward bias are selected to ensure pentode operation of all devices, the next step is to examine the diagram of figure 6 with a

view to selection of a value for the source resistor Rs.

In order that the circuit shall be capable of operation with all devices of the given type up to a reasonable temperature (say, 50 degrees C), no device should be permitted to adopt an operating point where its gate-source junction is forward biased. Hence if point A on the diagram represents the fixed zero-signal forward bias of 6V, and B represents the resulting Vgso at 50 degrees, the line B-D represents a lower limit on source resistor Rs. It can be seen that this line corresponds to an Rs which would cause a minimum limit device to adopt an operating point with Vgs = 0 at the given maximum temperature.

In the present circuit this means that the minimum value which we can choose for Rs is approximately 2.7K.

If the application of the circuit is such that signals applied to the JFET gate are normally only positive-going, the value of Rs can be made close to this minimum figure. With the voltmeter circuit being considered this would be a practical arrangement; in fact, for good linearity it is desirable because the closer our operating point is to the zero-bias situation the closer the working gm of the device will approach the maximum value gmo.

On the other hand, with some applications it may be necessary to provide for inputs being both negative and positive-going. In such cases the values of Rs will have to be increased, corresponding to a line such as B-X. The value would be chosen so that with the value of Vgso increased to correspond to the maximum negative signal excursion B-X crossed the vertical axis at a point no higher than the point Vgs = 0 for the minimum limit device.

It might appear that in settling on a value of 2.7K as a suitable source resistor for our JFETs, we have finally arrived at our basic voltmeter circuit. However, this is unfortunately not the case. In fact, if we look a little closer at figure 6 we will find that to a certain extent our problems have only just started; it is only now that we are really in a position to see some of the implications of the JFET parameter spread.

Reference back to the proposed circuit of figure 3 will show that the meter movement will be connected between the two sources. Hence in order that the meter can be zeroed for zero input, it will be necessary to arrange that for zero input the two sources can be brought to the same potential. Yet if we consider the line B-D of figure 6 we see that, for identical source resistors, two randomly selected devices are likely to have quiescent source voltages differing by as much as 6V or so. For a device near the minimum spread limit the operating point will be near "C," with the source at approximately earth potential; while a device near the maximum limit will operate near "D," with the source at about -6V.

Fairly clearly, we are going to need to adjust the source resistors individually if any pair of devices are to be operated with identical source voltages for the purpose of zero-setting. And if this is to be done while also ensuring that the input transistor operates at maximum gain (i.e., near-zero bias), the two resistors will need to be adjustable over a range of about 10:1—from about 2.7K

down to about 270ohms, the latter corresponding to the line B-E.

It is true that the zeroing control circuit of figure 3 can be arranged to permit this range of variation on a differential basis; thus RS1 and RS2 could be made 270ohms, and the zero pot 2.5K. But further consideration of figure 6 will show that a differential adjustment will not be satisfactory.

The reason for this is that differential adjustment of the two source resistors will only permit zero-setting; it will not ensure that the input JFET will be operating at near-maximum gain. Thus with two devices which are both near the maximum spread limit, zeroing will tend to cause both devices to operate well down their curve, and dynamic range and linearity will suffer. While with two devices which are both near the minimum spread limit, zeroing will tend to cause both to draw positive-bias grid current; and if this occurs normal behaviour will not be possible.

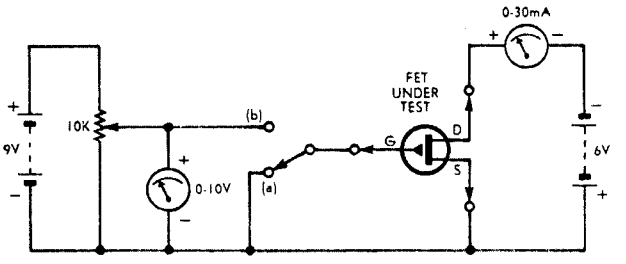


Fig. 8

The test circuit used by the author to select and match JFETs for the experimental voltmeter.

From this one may conclude that the only feasible approach would be to adjust the two source resistors **independently**—perhaps making each a series combination of a 270ohm fixed resistor and a 2.5K variable resistor. One would conceivably then be able to set up both operating points so that the zero setting coincided with the optimum bias on the input device.

Yet while this approach is feasible it would still not result in a really practical design. For one thing, it will generally not be permissible to operate devices which are near the maximum spread limit at near-zero bias, because if this were done the device dissipation ratings would be exceeded. Not only this but the current drain of the circuit would make battery operation virtually out of the question even if only **one** of the devices were near the maximum limit.

Apart from these considerations the linearity of the circuit would tend to vary rather considerably, and with devices having both a low gain and a low Idss it would probably be quite inadequate for the instrument to be taken seriously.

If there remain any readers of this article at this stage, it is hoped that these persistent souls will by now have begun to agree with the statement made by the author in the introduction: that the design of a voltmeter using low-cost JFETs is not quite as easy as it might seem. In fact, it would be quite understandable if such readers were now concluding that "it can't be done," although actually the situation is not **quite** as hopeless as it now might seem.

Most, if not all, of the problems which have been noted would be considerably alleviated if JFET parameter spread were restricted. It would appear, then, that a practical design could be produced by freeing our design requirements from the restriction that the circuit should operate correctly with **all** samples of the broad-spread "economy" devices.

If information were available from the device manufacturers regarding the frequency distributions of device parameters within the published limits, it might be feasible to adopt a statistical approach. Such an approach could involve contraction of the effective spread range, working on the basis that a known high percentage of sample devices would fall within the contracted range.

Unfortunately, the statistical information necessary for such an approach is not available, the device manufacturers being unwilling or unable to supply it. Therefore this approach is ruled out, and we are left with apparently only one course: that is, to use JFETs other than our hitherto-assumed randomly selected "economy" devices.

Whether we do this by purchasing "selected" economy devices, or by selecting our own from a purchased random batch, or even by simply forsaking the economy devices in favour of more expensive types with lower spread, the result is going to be inevitable. The effective device cost will rise, and along with it the cost of the instrument.

Hence any practical instrument which may become feasible as a result will be unlikely to satisfy the quest which originally prompted the exercise; it will tend to become a fairly costly "one off" instrument for the laboratory rather than an economy instrument for general workshop and field use.

Be that as it may, however, it would be unconstructive to end the present article without discussing at least briefly the available course of action. Accordingly, this will be done.

It would appear from inquiries made by the author while writing this article that "selected" economy JFETs are not currently available in this country, and that they are unlikely to be made available in the near future. It would also appear that JFETs having significantly reduced spread compared with the "economy" devices, are available only at a cost which would place them well outside the usual sphere of interest for individuals and small laboratories. Hence the only really practical approach seems to be to purchase a batch of random economy devices and perform one's own selection.

This may not be either as difficult or as costly as it may sound. The author found that in a random batch of eight devices of the 2N4360 type, two could be found which both matched one another closely and had Idss and Vp figures which allowed them to perform quite well in a prototype voltmeter circuit. Another two were not quite as well matched as the first pair, but would still perform quite satisfactorily. This may be a rather misleadingly fortuitous example, but it suggests that one might not have to purchase particularly large batches in order to obtain a useful pair of devices.

Figure 7 gives the circuit of a basic voltmeter which may be of interest as a starting point for experimentation. It has been designed to operate from a tapped 18V supply with a pair of 2N4360 devices selected on the following basis:

(a) Id at Vds = — 6V and Vgs = 0 closely matched, and within the range 4-10mA.

(b) Vgs at Vds = — 6V and Id one-tenth that in (a), again closely matched, and less than 7V.

A convenient way to make the selection of devices for this and similar circuits is by using a simple test setup similar to that shown in figure 8. With the gate switch in the lower position, the current meter reads the zero bias channel current, while with the switch in the upper position the voltmeter reads the reverse bias necessary to reduce this current by a factor of 10.

Source resistors R1 and R2 are selected on the basis of the current measured in the zero-bias test in (a) above, so that the JFETs are operated at close to the zero-bias point for maximum gain and linearity. To calculate the resistor values, simply divide the current reading obtained for the devices into 9V. Hence for a pair of devices with a zero-bias current of 4mA, R1 and R2 will be 2.2K, and so on.

It may be noted that a differential

zero set control is used, as with matched JFETs only minor adjustment will be needed. The calibrate resistor value of 200ohms should also be sufficient to cope with the reduced gain spread.

Although the basic measuring circuit will normally have an input voltage sensitivity of less than 1V, it is wise to arrange the input divider as shown in order that the input resistance can be a useful 11M while the JFET gate resistance remains below 2.5M. The reason for this is that for an appreciable proportion of 2N4360s the gate leakage current Igss will be sufficiently high to produce rather serious temperature dependent drift if the gate resistance rises higher than about 3M.

There is of course room for considerable experiment here; some may find that with the particular devices obtained it is quite in order to make the lowest range 1V f.s. while still retaining the full 11M input resistance, while others may elect to scale down the divider resistance to obtain satisfactory drift performance with almost any devices otherwise suitable.

The 100K resistor and zener diode shown on the circuit are for protection of the input JFET against overload damage. Although with the divider circuit shown they would not be essential, they would certainly become so if the divider were altered to allow the input to be applied to the gate without attenuation.

In closing this article brief mention should perhaps be made of JFET and MOSFET voltmeter designs more complex than the simple configuration which has been discussed herein. As some readers will no doubt be aware, a small number of such designs have been published, many of them based upon a DC feedback amplifier using an input JFET coupled to a silicon NPN bipolar transistor. (The configuration is rather similar to that used in the JFET preamp design published in the May issue.)

Generally speaking, the situation with such designs is even more complex than with the simple circuit which we have been considering; a fact which should scarcely be found surprising in view of the increased circuit complexity and the greater number of semiconductor devices involved.

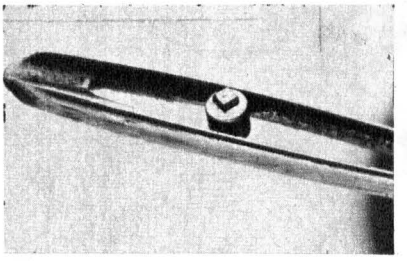
Many of the problems associated with such designs are very similar if not identical to those associated with the simple design. Not only this but as far as the author can judge, based upon both a fairly extensive computer-aided analysis and a survey of available designs and papers, most of the problems which reappear in the more complex designs are even more serious than with the simple case. And together with these, there are other problems arising from the additional circuit complexity itself.

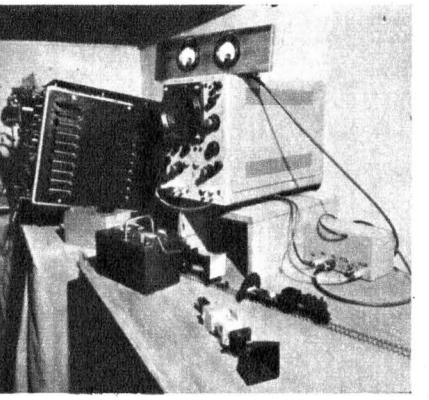
While the more complex designs were not given specific mention in the main discussion, then, many of the problems discussed will be equally if not more applicable to them than to the simple circuit which has been discussed.

The majority of these designs are intended specifically for "one off" laboratory applications where a very high input sensitivity must be attained despite considerable circuit complication, increased cost and the need to select individual devices. This being the case, the inclusion in the present article of a discussion of the additional problems associated with such designs was thought to be unwarranted. ■

KEEPING UP WITH semiconductors

. . . Gunn Effect Devices





At left is a gallium arsenide Gunn device chip held inside the eye of an ordinary sewing needle to show its small size. At right is an experimental Gunn device 8GHz Doppler speed measuring system which has been developed at Britain's Royal Radar Establishment in Worcester.

The Gunn Effect is a type of "bulk" semiconductor oscillation phenomenon in which a **simple chip** of a semiconductor material such as N-type gallium arsenide (GaAs) is seen to oscillate in the microwave region when the DC potential impressed across it exceeds a critical value. It was first observed in 1963 by J. B. Gunn of the IBM Corporation, although it had earlier been predicted from theory.

The effect has been studied mainly in GaAs, but is known to occur also in materials such as indium phosphide and arsenide, arsenic phosphate and cadmium telluride. In N-type GaAs material with a doping level producing 3 x 10^{15} carriers per cM^3, the effect occurs when the applied field exceeds a threshold value of the order of 3KV/cM. With a typical device having an active thickness of approximately 10 microns (10^{-6} M) this corresponds to an applied voltage of the order of 3V.

The theory of operation is as follows: In semiconductors such as GaAs there are two permissible energy bands available to conduction electrons, with an energy "gap" between them consisting of forbidden energy levels. The lower energy band is that associated with normal high-mobility conduction, while in the higher energy band electrons have relatively lower mobility. A high electric field can excite electrons from the lower energy high mobility band and transfer them to the higher energy band where they have lower mobility.

As the voltage applied to a chip of the material is increased from zero, the current first increases linearly with voltage according to the material's normal positive bulk resistance; the electrons are as yet in the lower energy band. However when the applied voltage reaches a critical value the field intensity at some point in the material will reach the value where electrons are transferred to the higher energy low mobility band. The place at which this occurs will be a region where the doping level is slightly reduced for some reason or another (doping variations, lattice defects, etc.).

The effect of this local excitation is to produce a "dipole layer" or "domain," consisting of a carrier concentration layer adjacent to a carrier depletion layer. Electrons reaching the local excitation region from the negative electrode tend to "bank up" on reaching the region, because they suddenly find themselves with reduced mobility; similarly at the positive side of the excitation region, electrons are able to regain their higher mobility and leave the vicinity rapidly, leaving a local shortage.

Under the influence of the applied electric field the domain region drifts through the material towards the positive electrode at the average electron drift velocity. The domain **drifts** rather than extends, because the region as originally produced absorbs sufficient of the device voltage drop to prevent further increase in the region thickness. For the same reason other regions are prevented from occurring, either at the place where the region nucleates or elsewhere in the material.

Until the domain reaches the positive electrode of the device, the effective current passed by the material is less than that passed just before the domain region formed. Hence there is a negative resistance effect, because current has **decreased** with the increase in applied voltage which was responsible for the production of the domain.

When the domain reaches the positive electrode, it disappears. The "bunch" of electrons in the concentration layer leave the material and the current momentarily rises. However, with the domain gone the applied field returns to its form, and almost immediately a new domain nucleates to repeat the cycle of events.

As each domain reaches the positive electrode the device passes a spurt of current; and because the domain repetition rate is governed by the time taken by a domain to drift from the point of nucleation to the positive electrode, reducing the thickness of the device permits the repetition rate to be made extremely high. To date Gunn Effect devices have been made to oscillate as high as 25-30GHz (1GHz=10^9 Hz).

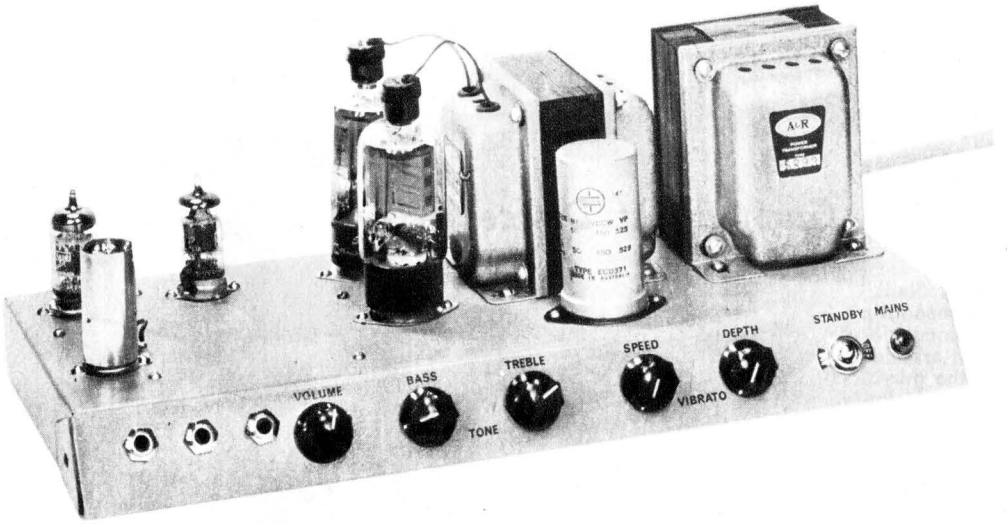
From the foregoing it may be seen that the operation of the Gunn Effect device is rather similar to that of a Klystron valve, in that operation depends upon the time taken by "bunches" of electrons to travel through the device. Note, however, that with the Gunn device the effective transit distance (and hence the transit time) is not a direct function of the actual device thickness, but is actually a function of the distance between the point of nucleation and the positive electrode.

This has produced a number of problems, not the least of which is that as yet it has proved extremely difficult to design a device to oscillate at a given frequency. Similarly it has been found rather difficult to tune Gunn devices over a practical frequency range.

Research is currently being made to find new techniques for solving these problems, with some researchers seeking ways to get tighter control over the purity and doping of the semi-conductor, while others are examining new device structures and tuning arrangements. Research is also being carried out into bulk semiconductor effects other than that discovered by Gunn; for example at Bell Laboratories they are currently examining devices which operate in a so-called "limited space-charge accumulation" (LSA) mode.

There is great expectation that bulk effect devices such as the Gunn device will permit many worthwhile advances in microwave techniques and applications. Already there is talk of "knapsack" TV link relays and small radar equipments the size of a hand torch.

For those interested in reading further, there are articles on Gunn and associated devices in **Electronics** (February 6, 1967, p. 127, and March 6, 1967, p. 134) and in **Plessey Electronics** (No. 1, November 1966, p. 15). (J.R.)



From the front and from underneath, the 60-watt amplifier looks little different from the 40-watt version featured last month. Note the more elaborate input system.

Guitar Amplifier — 60W Version

Following the presentation, last month, of a basic 40 watt guitar amplifier, we here give details of a more elaborate 60 watt version. Included in this latest design are specially "doctored" input facilities, having fixed amounts of bass and treble boost, and an optional "extra treble" circuit.

By Anthony Leo

In presenting the higher-powered version, we would stress that the rating is genuine: It will deliver to the loudspeaker system an actual output of 60 watts "undistorted." If operated under overload conditions for maximum sonic impact, as often happens with guitar amplifiers, it will deliver more power than this again.

The availability of audio power of this order automatically invokes the problem of providing loudspeakers to handle it. Obviously enough, it would be quite unrealistic to feed it into a system rated for, say, 20 watts and expect from it any kind of performance or durability. Any guitarist who aspires to use a 60-watt amplifier should be thinking in terms of multiple and/or very heavy duty loudspeakers, mounted in an adequate (and probably ponderous) enclosure. Particularly is this so for bass guitars or even ordinary guitars played so as to stress the lower register.

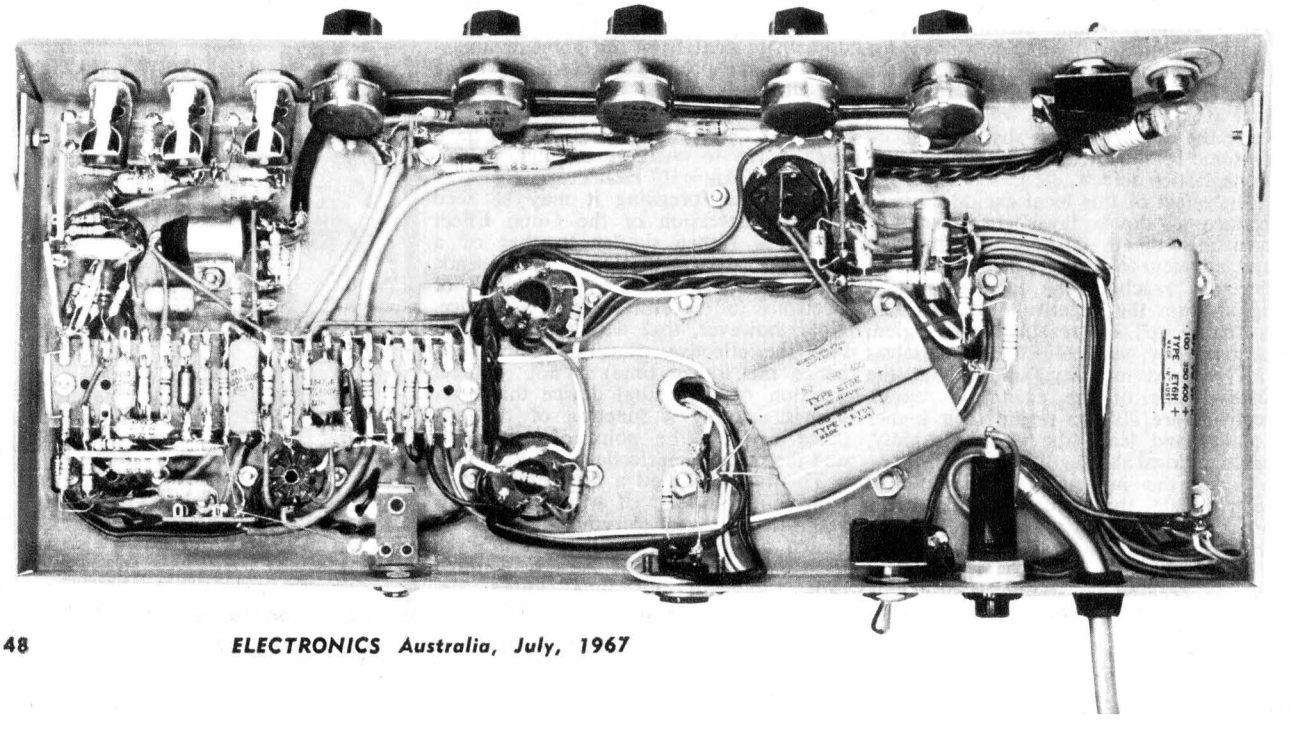
We may be able to say something about loudspeakers in a later issue but, for the time being, we can simply point up the need.

But why 60 watts — a figure well above that provided in the average electronic organ?

To some degree, there is a tendency amongst today's guitarists to regard high-powered amplifiers—and loudspeakers to match—as status symbols. What if they have to be transported in a large car and trundled in on castors? It's all part of the deal!

However, there is another side to it, in that guitar-group audiences aren't exactly noted for their silent attention, and the high power may well be necessary on occasions to ride over the competing ambient. But, whatever the motive, this 60-watt version should cope with just about any likely situation.

Over and above the provision of higher power output, on which we shall make further comment later in the



article, we have also provided a more elaborate input circuit, with three jacks individually compensated to favour lead, rhythm and bass guitars. The internal circuitry is such that there is a minimum of interaction between these input channels. If desired, two or even three guitars may be plugged in simultaneously and adjustment of the controls on one guitar will not significantly effect the balance from the others.

In making such provision, we are not seeking to contradict what is an accepted principle in guitar circles. Undoubtedly, the best presentation is obtained when the instruments operate through separate amplifiers and loudspeakers, each independently set up for optimum results. The total available power is greater and intermodulation is avoided, particularly in overstressed loudspeaker systems.

Provision of multiple, frequency-compensated inputs in our new amplifier serves a double purpose, however:

1. It makes it eminently suitable for any role, since selection of the proper input reinforces the action of the tone controls in the desired direction.

2. If the amplifier is to be used by more than one guitar, selection of the appropriate inputs provides an initial frequency differential, thereby simplifying the task of finding a suitable common setting for the major controls.

A rhythm guitar is usually played with the amplifier set for somewhere between "flat" and modest bass/treble boost, depending somewhat on the player, the instrument and the music. Accordingly, the input for rhythm accompaniment is "flat," the final balance being subject only to the amplifier tone controls and, of course, the tone controls on the guitar itself.

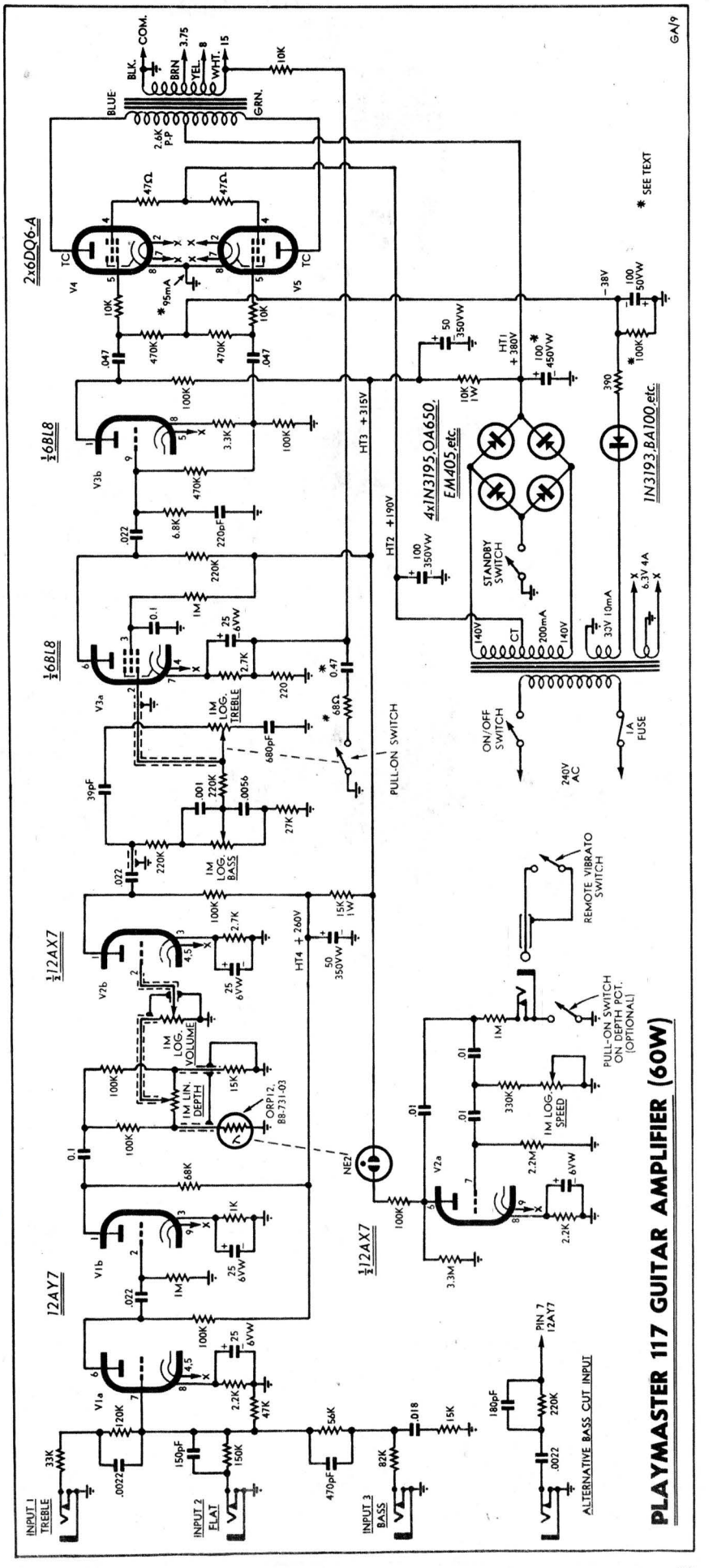
For lead guitar, more treble boost is normally desired and, accordingly, the input network for lead guitar provides an additional 6dB boost at 2KHz. With the treble control at maximum, something over 16dB of treble boost is available at 5KHz, which should meet all but extreme requirements.

For bass work, the bass input network provides an extra 8dB boost at 100HZ, making the total available bass boost about 25dB.

While we show one network of each type on the main circuit, individual constructors may elect to vary this to suit their own needs, putting in two "flat" inputs and two "treble boost" inputs and so on.

While on the subject of options, we show separately in the circuit another type of input network which provides a considerable degree of bass cut. This may be

Superficially, the circuit looks much the same as the 116 design featured last month. However, the revised operating conditions for the output stage, including the use of more expensive grain-orientated transformers, gives a 50pc increase in power output. Other provisions include a more elaborate input system, the use of a premium quality preamplifier valve and an "extra treble" facility operating on the main feedback loop; these latter features can be added, if desired, to the 116 circuit.



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PARTS LIST

1 Chassis 16in x 7in x 1½in with outward sloping front panel.
1 Power transformer 240V to 280V at 200 mA with centre tap, 30V bias winding, and 6.3V at 4A with centre tap. A and R Transformer type PT5893, or similar.
1 Output transformer 2.6Kohms plate to plate with 3.75, 8 and 15 ohm secondary taps. A and R transformer type OT2842, or similar.
2 Octal valve sockets.
1 9-pin shielded valve socket.
2 9-pin valve sockets.
2 6DQ6A valves, 1 6BL8 valve, 1 12AX7 valve, 1 12AY7 valve.
4 Power diodes, types EM405, IN3195, OA650, or similar.
1 Bias supply diode, types, BA100, IN3193, or similar.
1LDR, type ORP12, B8-731-03, etc.
1 Neon lamp, type NE2.

CAPACITORS

1 100uF 450VW electrolytic.
1 100uF 350VW electrolytic.
2 50uF 350VW electrolytic.
1 100uF 50VW electrolytic.
5 25uF 6VW electrolytic.
1 0.47uF L.V. ceramic.
2 0.1uF 400V plastic.
2 .047uF 400V plastic.
3 .022uF 400V plastic.
3 .01uF 400V plastic.
1 .018 L.V. plastic.
1 .0056uF L.V. plastic.
1 .0022 L.V. plastic.
1 .001uF L.V. plastic.
1 680pF L.V. plastic.
1 470pF L.V. plastic.
1 220pF L.V. ceramic.
1 150pF L.V. plastic.
1 39pF L.V. ceramic.

RESISTORS

½-watt, 10 per cent, unless specified.
1x3.3M, 1x2.2M, 3x470K, 1x330K, 3x220K, 1x150K, 1x120K, 8x100K, 1x82K, 1x56K, 1x47K, 1x33K, 1x27K, 1x18K, 2x15K, 1x15K, 1 watt, 3x10K, 1x10K, 1 watt, 1x6.8K, 1x3.3K, 2x2.7K, 2x2.2K, 1x1K, 1x470 ohms, 1x220 ohms, 1x68 ohms, 2x47 ohms.

POTENTIOMETERS

4 1M log. (C-taper).
1 1M linear (A-taper).

MISCELLANEOUS

1x8-way tag strip, 2x6-way tag strips, 1x5-way tag strip, 1x4-way tag strip, 1x3-way tag strip, 3x2-way tag strips, 21 lug length of miniature resistor panel.
2 single pole toggle switches.
1 pilot lamp assembly.
1 fuse holder.
4 "shorting" type jack sockets and plugs.
1 4-pin speaker socket and plug.
Power flex and plug, clamp and rubber grommet, knobs, shielded cable, hookup wire, nuts, bolts, washers, solder, etc. Remote foot switch and mounting, if desired.

useful in situations where one guitarist wants consistently to use more bass boost in the amplifier than a second guitarist finds acceptable.

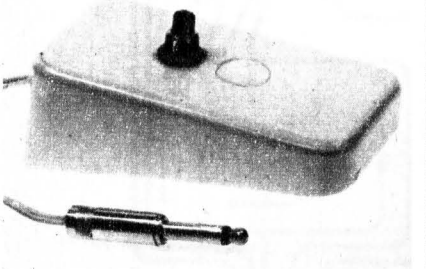
A further option is a modification to the main negative feedback loop which will provide the amplifier with an additional 6dB of treble boost at 3KHz. We devised the modification after observing that a particular group, who checked the amplifier for us, seemed to regard "normal" treble as something above what actual measurement showed to be level. The modification can be wired in permanently or brought into circuit by means of a "pull-on" switch attached to the rear of the treble tone control. In this way, operation of the switch will add 6dB of treble boost to whatever the control would otherwise determine.

Obviously enough, any treble boost so obtained from the feedback network must be at the expense of the total effective feedback. In other words, if we have 16dB of negative feedback and we wish to provide 6dB boost, the feedback will of necessity be reduced by about 6dB at the boosted frequencies. Fortunately, 10dB of negative feedback is adequate for an amplifier of this type. The network consisting of a 680 ohm resistor in series with a 0.47uF capacitor is shown dotted on the circuit diagram.

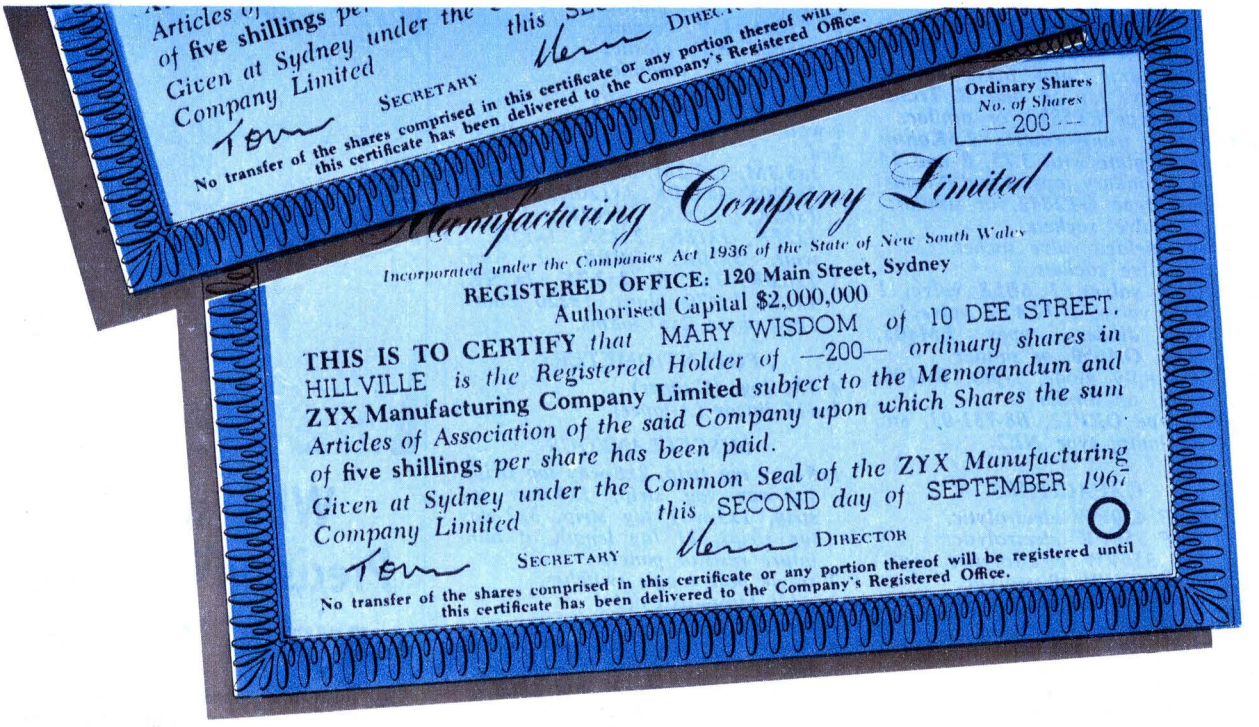
The modified input networks introduce an inevitable loss of gain which could render the amplifier not quite sensitive enough for low output guitars. Replacement of the 12AU7 in the first stage with a 12AX7 would more than offset this but could mean that the input circuits might overload too readily with higher than average signal voltages. Accordingly, we have specified a 12AY7, a less well known premium-quality valve, with a gain midway between the other two. It has the additional advantage of low-noise low-microphony construction and is therefore a good choice for situations where high energy from bass loudspeakers could vibrate the amplifier chassis.

Incidentally, all these modifications—the frequency compensated inputs, the 12AY7 valve and the treble boost in the feedback network—are immediately applicable to the 40-watt amplifier described last month.

A suitable tagstrip will need to be installed adjacent to the input jacks to carry the three networks. We used an 8-lug tagstrip, wired as indicated in the accompanying diagram and mounted by the screw which earlier had held the modulator component tagstrip. The lat-



The vibrato off-on foot switch is the same as specified for our original Playmaster 102 and 103 guitar amplifiers. It can be used as well as or instead of a switch on the rear of the "Depth" control potentiometer.



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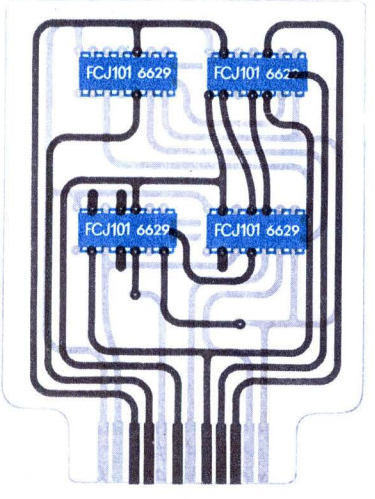

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ter has been relocated further back, both to avoid crowding and to keep later wiring away from the input components.

Having looked at the modified input arrangements, we can describe the modifications to the output and power supply stages, necessary for the amplifier to deliver the additional 20 watts.

As we mentioned last month, the power output stage employs two 6DQ6A power valves operating push-pull in class AB1, with fixed grid bias. In the 40-watt unit, the total cathode current for the two valves was 100mA (quiescent), a figure determined mainly by the amount of negative grid-bias applied.

POWER: 60 watts RMS output.
DISTORTION: Total harmonic distortion at 60 watts output is 2 per cent, and 1 per cent at 55 watts output.
INPUT SENSITIVITY: 20mV for 60 watts output at 500Hz.
LOAD IMPEDANCE: 3.75, 8 or 15 ohms.

To obtain the additional power output, it is necessary to modify the operating conditions of the output valves, involving a slight increase in plate voltage, a slight increase in grid signal swing and a reduction in the plate-to-plate load impedance from 3300 ohms to 2600 ohms.

The increase in supply voltage must be countered by a reduction of 5 milliamps in standing current, if the plate dissipation of the output valves is to be kept inside the limit figure of 18 watts apiece.

Reduction of the quiescent current naturally involves a modification to the bias supply, the required bias now being about —38 volts. The bias voltage should be adjusted, by varying the 100K shunt, to give a total cathode current of 95mA.

Other than the bias supply, the power supply components, with the exception of the power transformer itself, are the same as those for the lower power version.

Although the quiescent current has been reduced, the current drawn at the peaks of the signal excursion will be considerably greater than it was for the 40 watt version, substantially increasing the average current drawn under dynamic conditions. This, together with the increased HT voltage, means that the power supply is called upon to deliver substantially more power.

The new power transformer has a secondary voltage rating of 280V overall with a nominal current capacity of 200mA.

Although both transformers must handle considerably more power in this amplifier, they are physically no larger than those for the 40-watt version. This is made possible by the use of grain-orientated laminations in the transformer cores.

When the silicon steel for transformer laminations is rolled, an alignment of the crystaline structure occurs, forming a grain in the direction of the rolling. It is found that the steel presents less reluctance to the magnetising force, along its grain, than it does across the grain structure; reluctance is the magnetic analogue of electrical resistance. By stamping-out laminations with the grain orientated in the direction of the longest magnetic path, a transformer can be produced which has lower magnetic resistance and so higher flux density in its core.

By selecting high quality material, taking advantage of grain orientation and using thinner than usual laminations to reduce eddy current loss, it is possible to produce transformers which will handle considerably more power than regular transformers of the same physical size.

Not surprisingly, there is a price to be paid for this and the higher rated power transformer, together with the new output transformer, will cost several dollars more than those for the 40-watt version. (The transformers used in our new amplifier were A & R types, PT5893 and OT 2842, but equivalent units will probably be made available by other manufacturers.)

Apart from the new transformers and the modified input circuitry, the layout of the basic amplifier has not been changed.

Again we are using the previously described vibrato system, wherein "modulation" of the guitar signal is effected by means of a light dependant resistor in a balanced resistance network. Guitarists who tested the amplifier voted it as about the best vibrato they had ever used, the amplifier showing no tendency to "pump" the loudspeaker cones. The vibrato may be switched by either a switch on the depth control, as indicated in the circuit, or activated by a remote foot switch.

The remote vibrato on/off switch, as pictured, consists of a robust "button" switch, mounted in a small plastic box which has been suitably tapered to a wedge shape, so as to facilitate foot operation. The actual switch may be either of two types, a push-on and push-off type or a push on type with a self returning spring action. Either way, the assembly must be of such construction

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Measurement ranges available

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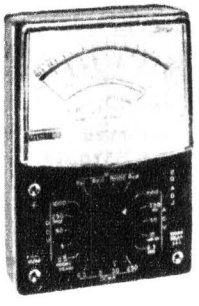
DC current: 50μa, 1ma, 10ma, 50ma, 250ma, 1a, 10a
AC current: 250ma, 1a, 10a
Resistance: From 30 ohms to 300k ohms Midscale in four ranges. **Volume level:** — 20~ + 62db



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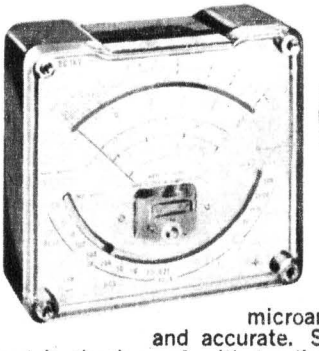
A protection circuit safeguards the meter movement. Shunt adaptors are available to give ranges up to 25 amperes DC.

Measurement ranges available

DC voltage: 0.1v, 0.5v, 5v, 50v, 250v, 1000v (20k Ω/v)
AC voltage: 2.5v, 10v, 50v, 250v, 1000v (8k Ω/v)
DC current: 50μa, 0.5ma, 5ma, 50ma, 250ma
Resistance: From 50 ohms to 50k ohms in four ranges
Volume level: — 20~ + 62db



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Measurement ranges available

DC voltage: 0.25v, 2.5v, 10v, 50v, 250v, 500v, 1000v (25k Ω/v)
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DC current: 40μa, 0.5ma, 5ma, 50ma, 500ma
Resistance: From 100 ohms to 250k ohms Midscale in four ranges. **Load current: LI** — 15ma, 1.5ma, 150μa
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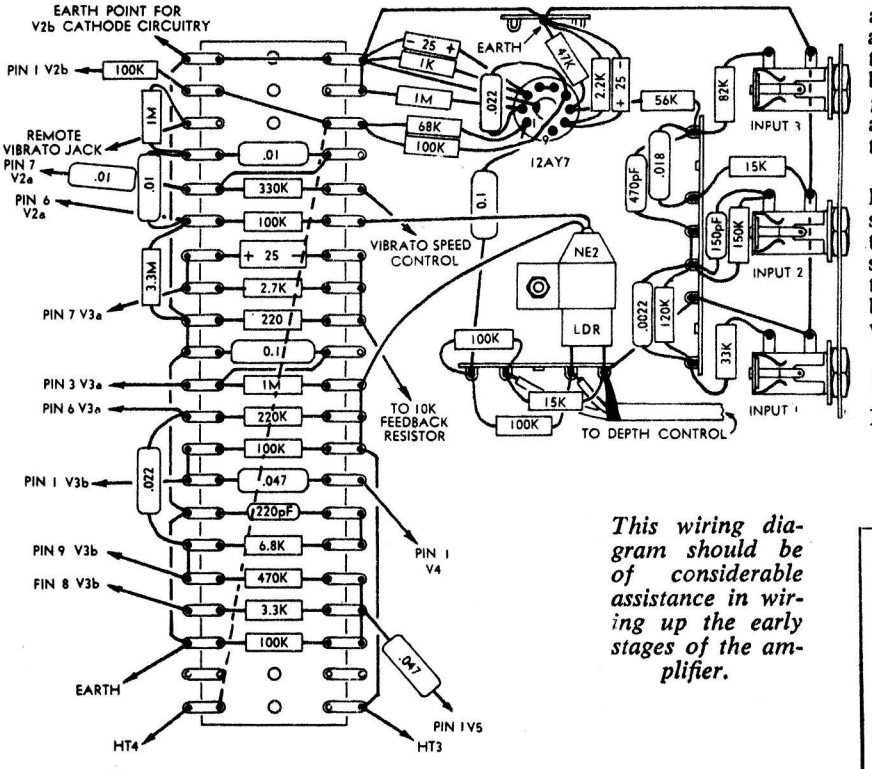
ADELAIDE: 23-3233. **BRISBANE:** 51-5121. **CANBERRA:** 4-7755. **HOBART:** Associated Agencies Pty. Ltd. 2-1841. **LAUNCESTON:** Associated Agencies Pty. Ltd. 2-1318. **MELBOURNE:** 69-0151. **MOUNT GAMBIER:** 2-3841. **NEWCASTLE WEST:** 61-4077. **PERTH:** Henderson Instrument Co. Pty. Ltd. 8-4131. **SYDNEY:** 29-1111. **WOLLONGONG:** 2-5444 and appointed wholesalers.



This wiring diagram should be of considerable assistance in wiring up the early stages of the amplifier.

as to stand plenty of knocking about. The foot switch is connected to the amplifier by a length of small diameter figure-8 twin flex with a standard telephone jack.

Our switch container was made from a small plastic box manufactured by Watkin Wynne Pty. Ltd. and measuring 4¼ x 2-5/8 x 1-5/8in. The rear edges were tapered to obtain the wedge shape and two holes drilled, one toward the "high" end and on top to mount the "button" switch and the other in the high end itself, through which the cord passes. In addition to a grommet being placed in the latter hole, some means of securing the cord should be provided, to prevent mechanical strain being placed on the soldered switch connections.

Should a more robust foot switch be required, an auto headlamp dip switch could be mounted in a metal box; the metal box could be folded from heavy gauge sheet aluminium. An alternative arrangement might be a wedge shaped wooden block which has been suitably hollowed out so as to accomodate the switch.

A switch which appeared to be rugged enough to withstand severe punishment is made by Alpha Engineering Co. Pty. Ltd. of Sydney, and marketed under the trade name of "Alpha."

Construction of the amplifier is virtually identical to the Playmaster 116, with the exception of the additional tag strip at the input which we mentioned previously.

Again we would sound a word of warning regarding the feedback connection, which should be made after the output and driving stage is functioning normally. If the amplifier remains stable after the feedback connection is made and there is a drop in the level of any test signal from the amplifier, the feedback is negative and all is well. If the gain increases, however, and/or the amplifier howls, it is a sure sign that the feedback is positive.

Since it is logical, and an unwritten law, to leave the common end of the secondary earthed and not to cross over the flying leads to the output valves, the simplest modification is to swap over the "drive" leads from the component board to the grids of the two output valves. ■

BASIC RADIO COURSE:

On page 61 of this issue we present what is, in effect, an additional chapter for your "Basic Radio Course"—the first of two which will cover the subject of television. The author, by the way, is our Associate Editor, Philip Watson.

You may care to cut out the relevant pages and keep them inside your copy of the course.

For those who may not have been aware of it, complete bound reprints of the Basic Radio Course (Chapters 1-24) are available from our office at $1.50, or at $1.60 posted to any address in Australia.

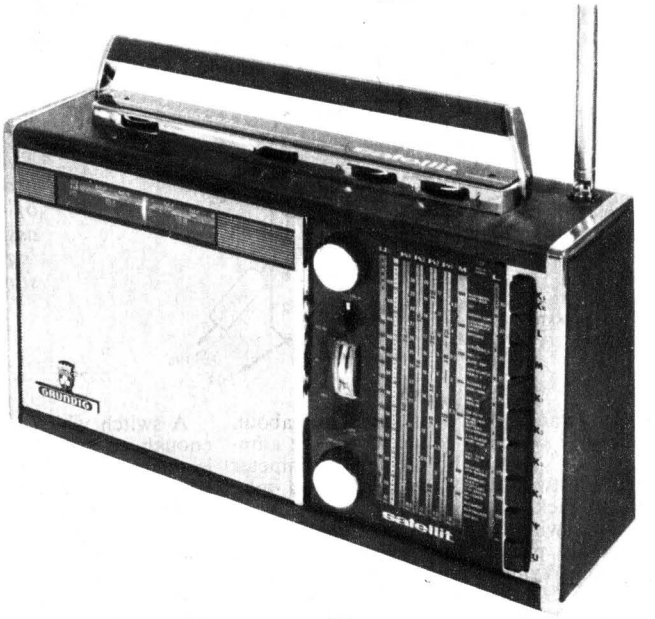
ERRATA AND NOTES

Playmaster 115, April, 1967. Corrections to parts list: The power transformer secondary should be 70V.CT, not 75V.CT. The balance potentiometer should be 2M (lin), not 1M.

Grundig world-range radios

TR5000

The Grundig name has become a legend for quality in radio sound. And with radios like the extraordinary Grundig Sattelit, it's no wonder! You can be an eavesdropper on the world. Two Superphon dynamic loudspeakers give you world-wide reception on thirteen wavebands—with an unbelievable depth and clarity of sound. Short wave, FM, bandspread, too! The Satellit TR5000 is designed to operate on batteries or AC mains, and receives VHF/FM, long, medium and short wavebands. The short wave coverage ranges from 10 to 187 m., split into four bands.



Additionally, six bandspread short wave ranges are provided, shown on a separate scale with a rotating drum selector. The Satellit is fitted with 17 transistors and 11 diodes. It features a short wave fine tuning dial, automatic frequency control on FM, R.F. stage, a switchable ferrite aerial, a double extension telescopic aerial, a separate control for the bandspread short wave tuner, duplex drive on FM/AM, a tuning and battery indicator, and two multi-octave loudspeakers. The Satellit also has an illuminated tuning scale and separate bass and treble controls. Sockets are provided for headphones, external aerial and earth, car aerial, record player, tape recorder and external battery power supply.
The Satellit transistor 5000 has a handsome padded graphite case with chrome and satin silver trim. It measures 16" x 10" x 4¾".

TR3000

The Ocean Boy TR3000 is not just a transistor radio, it is a perfect piece of precision engineering. The whole world's your oyster with the Grundig TR3000. Choose a wavelength by pressing one of the nine buttons and using the fine tuning control. See visually when you are at the point of best reception by the tuning indicator (which doubles as battery indicator). Adjust the bass and treble tone controls and you're hearing a radio that's built for listening to, not straining at. The Ocean Boy has two loudspeakers, 13 transistors, 8 diodes and 2 rectifiers. Provides matchless listening on VHF/FM, long, medium and 4 short wavebands (10 to 185 m.). Output is up to 2 watts (R.M.S.).

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GEP344R

GRUNDIG . . . the world's largest manufacturer of tape recorders . . . stereograms . . . and dictating machines.

The Serviceman

WHAT'S IN A NAME—OR A BRAND?

"Someone's not playing the cards I dealt 'em!" So runs the rather classic quip. Perhaps not surprisingly, it came to mind when I sat down to recount this month's main story.

It began in a perfectly routine fashion with a telephoned complaint from a set owner that the picture on his TV screen was getting less and less clear and he'd decided that it was about time he had someone look at the set. He volunteered, further, "that the picture seemed to have wriggly dots all over it."

From the description, I gathered that the "wriggly dots" would probably be what we would more commonly describe as "snow" or "noise" in the picture — and this is what it turned out to be, when I was at last confronted by the offending receiver.

Perhaps a word of explanation would not be amiss for the rising generation of would-be servicemen:

Most of the spurious signals which produce these disturbances on the screen occur in the circuits and valves in the front end of the receiver itself, and are due to slight irregulatities in current flow. With a strong input signal these disturbances are so weak by comparison that they are of little consequence. Providing the set's AGC system is working correctly, so that the gain of the set is suitably reduced to prevent overload, this favourable signal-to-noise ratio will be maintained right through the set to the picture tube. The picture is, therefore displayed to best advantage.

However, when the incoming signal is weak the disturbances in the front end circuits may well approach them in magnitude, resulting in a poor signal-to-noise ratio. To be sure, the AGC system will have sensed the weaker signal and advanced the gain of the set to cope with it, but this will do nothing to improve the signal to noise ratio. All that will happen is that the disturbances will be amplified along with the wanted signal, and eventually appear on the picture tube screen as "wriggly dots." In an ordinary sound-only receiver, the spurious signal is heard as a rushing or swishing sound and the term "noise" is therefore appropriate.

In a television receiver, the same phenomenon produces "wriggly dots" on the screen, mixed up with the wanted image. In some cases, the effect is described as "snow" but, in technical circles, it is more usual to stick to the word "noise." In fact, "noise" is used very widely throughout the electronics industry to describe the spurious energy which a circuit or a piece of equipment superimposes on any kind of wanted electrical signal.

Well, after that "Answer Man" effort, I'd better get back to my original story.

Taken out of a television tuner, this valve is very clearly branded 6BQ7A, but . . . .

Faced with visual "noise" in a television receiver, the first thing to suspect is the aerial and its connections, for any fault here will interrupt the signal to the receiver, causing the AGC circuit to advance the gain in an effort to compensate — with the result already outlined.

So I slid the set out from the wall, checked to see that both sides of the aerial lead-in were connected — to the right terminals — and that the input was not being shorted out by a stray strand of wire. But everything appeared to be in order in this department, and with the lead-in to where it disappeared through the wall.

So I walked out through the back door and followed its further path along the wall, out over the guttering and up to the aerial. Again, as far as I could see, nothing was wrong but I did note that, helpfully, the aerial was of a type having a folded active element that should show up as a DC short across the ends of the feedline. Accordingly, I disconnected the lead-in from the set and measured across the two ends with an ohmmeter. It showed very low DC resistance, indicating that the circuit was apparently complete, up one feedwire, through the folded dipole and back down the other feedwire.

Assuming the aerial to be in order, the noise problem looked like having to do with the receiver itself.

Typically, there could be a faulty valve in the tuner or a faulty component, connection or contact. If any of the latter, I might face the decision of having to fiddle with the tuner on the spot, risking waste of time and possible failure, or else taking the tuner out and sending it back to a repair depot. Understandably, servicemen don't like faults in tuners!

As against a possible tuner fault, there was one other "hope" — a fault in the AGC circuit to the IF amplifier. If an open resistor or a leaky bypass capacitor prevents AGC voltage from reaching the IF system, it operates "flat out" and causes a very high AGC voltage to be applied to the tuner. If the tuner AGC is high enough to cut off plate current in the RF amplifier valve, only the merest trace of signal may get through but the IF amplifier will amplify it, along with "noise" from the frequency changer, to produce a "noisy" picture.

But, with the hope that it wouldn't be as complicated as all this, I reached in and pulled out the RF amplifier valve — a 6BQ7A. What there was of the picture disappeared forthwith. Reaching into my kit, I pulled out a spare 6BQ7A, plugged it in and waited for the picture to reappear — I hoped, free of noise.

But in vain. The picture, when it appeared, was even "noisier" than before!

Strange, my spare 6BQ7A must be a dud! With some misgiving, I went out to the truck and brought in a couple more. But neither of these was any better. Yet, when I put back the original 6BQ7A, the picture reappeared in its original, rather noisy form.

What the hec?

Then, suddenly, the bells began to ring. The set was of a type which always used a particular brand of tuner and these tuners NEVER used a 6BQ7A! They always used a 6ES8.

What was I doing then, plugging in 6BQ7A's? And how come that I'd pulled a 6BQ7A out of it?

So, for the first time, I took a good look at the original "6BQ7A." Despite its very clear brand, it was nothing of the kind. Instead of the two slim triode structures inside, it had the more involved and bulky shielding that characterised the 6ES8 that it should have been — and was!

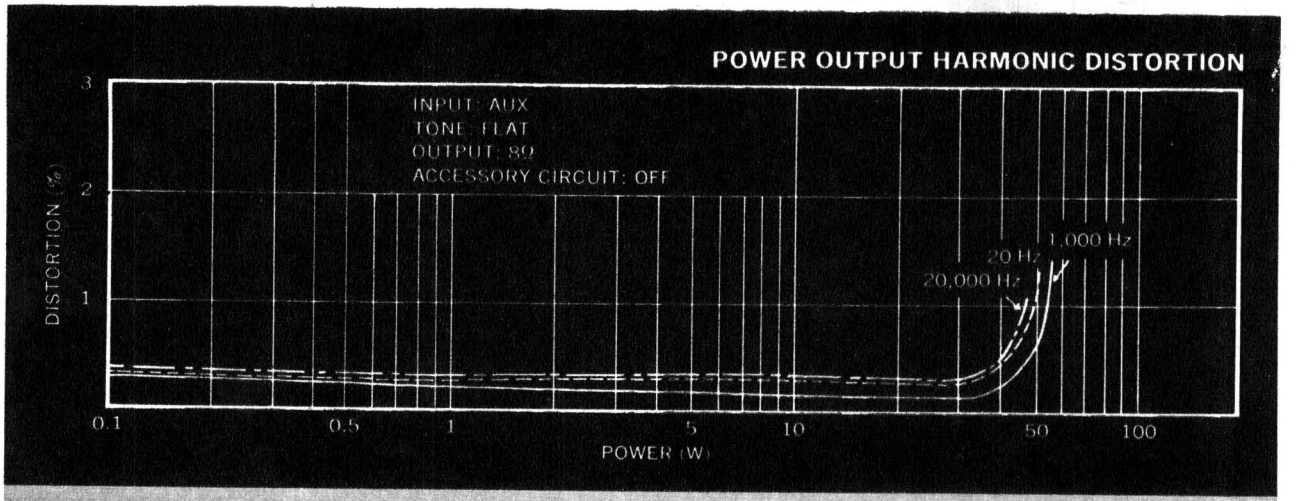
And, sure enough, when I plugged in

More light on colour television

Strictly incognito, your Serviceman was wandering around the recent IREE convention displays and noted a photographer getting all set to take some pictures off one of the colour television screens. A few minutes later, the program began to roll and the photographer started systematically to snap the best scenes—with the aid of a flashlight!

What a set of pictures would be his reward . . . a whole roll of pictures of a colour set with a blank screen.

Somebody should have told him that a colour television image is not an object—therefore it can't be illuminated by incident light. The image is itself a pattern of light and hitting it with a flash would simply wash it out. What would happen to the picture on the screen of your favourite drive-in if all the cars turned their headlights on to it?



Sansui lays it on the line

Look at that distortion curve.

It, better than pages of exaggerated advertising claims, tells the serious stereo fan something about the kind of engineering that has gone into building a receiver.

While this curve belongs to Sansui's Model 3000, it is the result of the same engineering, the same careful component selection, and the same precision fabrication that goes into every product carrying the Sansui name.

Sansui's line of audio equipment includes more than a dozen quality receivers at all power outputs — solid-states, tube types, single or multiple band tuners, amplifiers, amplifier-tuners—as well as matching speaker systems and stereo headphone sets.

Pick up specifications for any Sansui product and you'll find performance and distortion characteristics laid on the line as few stereo equipment manufacturers would dare.

Then listen to a Sansui at your dealer for a frank personal appraisal.

Sansui model 3000: Solid-State AM/FM Multiplex Stereo Receiver. Total output power: 130 watts. RMS power: 48/48 watts. Stereo RMS power: 45 watts x 2. Bandwidth: 20 to 20,000 Hz. Harmonic Distortion: less than 1% at all power levels.

Sansui®

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a new 6ES8 the picture came up with exactly the same order of noise as when I had first switched it on.

As it transpired, the noise disappeared the moment I replaced the frequency changer — which was the next step — but I left the place with a shake of the head. As if television receivers haven't enough tricks of their own, without bugging them with wrongly branded valves!

How did it get there in the first place? Because, I imagine, people in the valve factory identify valves by batches and by appearance, rather than by reading every individual type number. And the same would go for the person who plugged the wrongly branded valve into the tuner. It looked right, it worked right and it was right — except for the brand.

But what a mess I'd have got into if I hadn't been quite so familiar with the particular brand of receiver!

As compared with this call, which was very much out of the ordinary, the next call on my list was of the kind that I don't enjoy, any more than any other serviceman.

The complaint, in this case, was that the set had lost its picture altogether, apart from a few white streaks. When I took a look at the screen, I quickly realised that the white streaks were simply highlights from the picture — the only part of it that was visible.

It seemed clear enough that the brightness circuit had developed a fault so that, even turned right up, the brightness control did not raise the picture tube above beam cut-off. In an effort to correct the situation, the owner had turned the contrast to maximum, causing just the peak whites to break through.

A bit of probing around the leads to the picture tube socket confirmed that the grid potential was well below cathode potential, irrespective of the brightness control setting. This much was not hard to verify. The unwelcome thought was that the component responsible, either a resistor or a bypass, was hidden away in the chassis, which was going to take me a half-hour or so to remove and reinstall. I did it without much in the way of good grace and my mood wasn't improved when the owner quibbed about the fee, on the grounds that I surely wasn't going to charge all that for one tiny little "resistor thing."

But, if there was a risk of generating hard feelings about owners in general, the temptation was countered by the knowledge of the "swifty" that a few servicemen have been known to pull in these same circumstances.

Through ignorance or by design, they blame the dim picture on a failing tube and proceed smartly to sell and fit a picture tube brightener. Prompted by the increased heater voltage, the tube produces a more normal picture — for a time! In fact, the receiver still contains the original fault but, by the time it is traced and corrected, the picture tube is on its way to an early demise.

I wonder how such operators can sleep at nights.

By way of a change from television, here's a story which may be of interest to "audio" types.

It actually started with a call to fix a fault in a television set—a call and a fault which, in themselves, would not have warranted any comment. However, with that job done, the owner asked me whether he could pay for a few extra minutes of my time, to have a look at a peculiar fault in his home-made hi-fi system.

I hummed and harred for a few moments, to clear the way for a hasty retreat, should it have proved to be necessary. Home constructors don't always realise that it involves an outlay of real time to become familiar with their circuits, their method of construction and their problem before one can begin to diagnose and "prescribe." And somebody has to pay for this time, if the serviceman is not to work for nothing!

As it transpired, the equipment was not home constructed in the normal sense of the term. My client had bought a crystal cartridge, player, amplifier and loudspeakers separately and assembled them in his own cabinet. And I must say that the sound was excellent, considering his relatively modest outlay.

The one trouble was that the system would not play the extreme outside grooves of a few of his records—and this he proceeded to demonstrate. The pickup could be lowered manually on to the run-in grooves, would appear to "seat" normally and then, just before the music started, the pickup would jump inwards by about 1/8-inch, missing the opening stanzas altogether. On other records, it was perfectly normal.

The natural thing was to suspect some roughness in the vertical bearing, causing the pickup to jump over a high spot. But I certainly couldn't feel any roughness—and why should it happen so positively on particular records, with no hint of trouble on others?

Close examination revealed that the records which were giving trouble were those with a rolled, rather than a flat edge and my first guess was that the stylus was simply sliding downhill. But lowering the pickup gently to where there could be no "hill" didn't overcome the effect. However, in an effort to clarify the situation I undid a couple of screws and propped up one end of the motor board so that the pickup arm had to climb up a definite incline towards the centre of the record. But, alas, on the troublesome records it flipped towards the centre as positively as ever.

In an effort to watch more closely the behaviour of the stylus in the groove, I got down on my haunches, end on to the pickup and had my client hold a torch on the scene while I slowly lowered the pickup into the outer groove.

And, suddenly I spotted the cause. On either side of the stylus, the underside of the cartridge had a slight shoulder, perhaps intended to limit upward thrust of the stylus in the event of the pickup being dropped on to the record. Normally, the shoulders rode just clear of the surface but, on the troublesome discs, the outer shoulder in this case was just fouling the rolled edge. Just as the drag on a stylus tends to pull a pickup towards the centre of a disc, so this unusual friction flipped the pickup violently inwards.

I suggested to the owner that the stylus may have been bending—or have been bent—by excessive playing weight, or that the socket through which it excited the crystal may have been slightly out of position. Yet again, he might be able, very carefully, to file away a little of the offending shoulder.

What he will do about it I'm not sure but my impression, as I took my leave, was that he would probably buy a new cartridge. I gained the impression that he'd been looking for an excuse, anyway, to shout himself a new diamond-tipped ceramic! ◻

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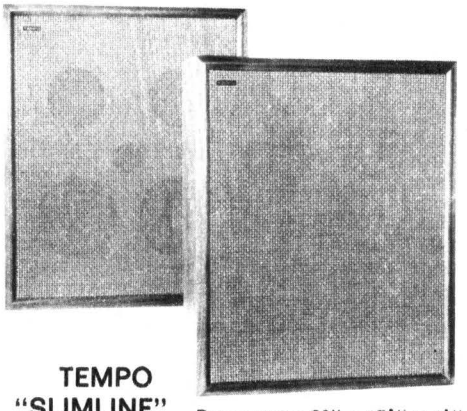
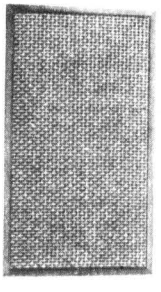


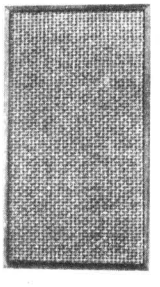
TEMPO "SLIMLINE" LOUD SPEAKERS

Dimensions 22" x 17⅜" x 4½" Number of loudspeakers: 10 (5 to each cabinet). Impedance: 8 ohms. Output: 25 watts.



TEMPO BOOKSHELF SPEAKERS

are also available in two sizes: 'MINI', 14" x 8" x 8" and 'PEERLESS', 21" x 11" x 9".



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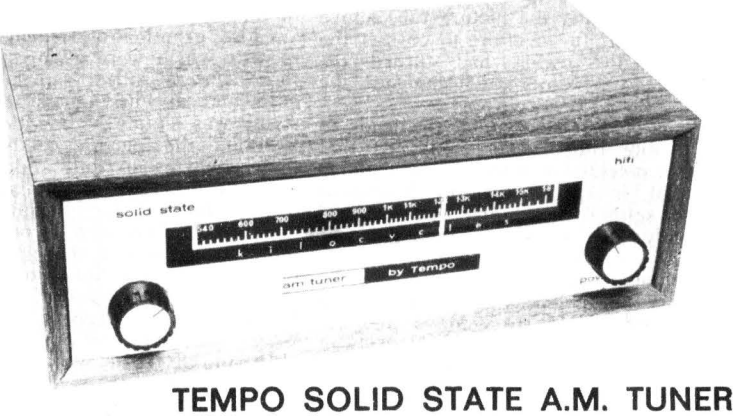
Specifications: **RADIO:** 540 Kcs to 1650 Kcs. **OUTPUT:** 8 ohms, 10 watts (max) per channel. 2 x 7 watts R.M.S. **RESPONSE:** 20-20,000 C.P.S. will accept either magnetic or ceramic pick-up. Headphone socket provided on front panel. Auxiliary input for tape recorder or TV. 240 volt 50 cycle. Attractive walnut case.

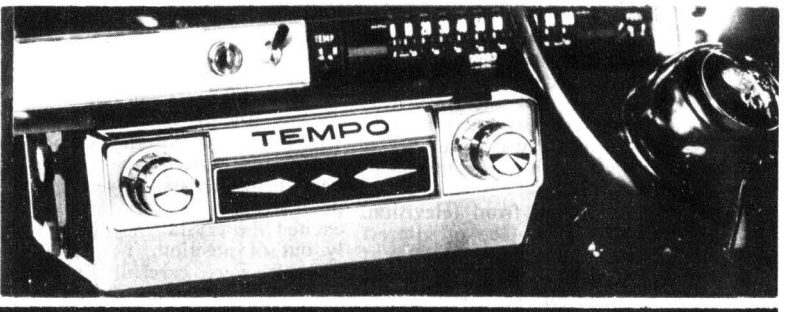


TEMPO SOLID STATE A.M. TUNER TO ADD QUALITY RADIO REPRODUCTION TO YOUR EXISTING HI-FI SYSTEM

Specifications: **BANDWIDTH** 10 Kcs. **TUNING RANGE** 525-1620 Kcs. **COMPLEMENT** 2 diodes, 5 transistors. **WHISTLE FILTER** low pass to 5.5 Kcs. **ANTENNA** internal loop & ferrite rod. **OPERATING VOLTAGE** 240 volts A.C. **OUTPUT** variable, preset between, 200 & 750 MV. **DIMENSIONS** width: 11½", depth: 6½", height: 4½" (including feet). **CONTROLS** front on/off, tuning knob, rear output preset gain, whistle filter switch. **FEATURES:** removable one piece escutcheon and chassis, illuminated dial and pointer. Provision for external antenna-terminal.

FOR THE CAR..TEMPO FULLY SOLID STATE 8-TRACK STEREO

Measuring only 8" wide and 3" high the Tempo Car Stereo brings you superb stereo musical reproduction without static or commercials. It's easy to install, and tapes can be changed quickly and easily without rewinding. Specifications: **WEIGHT:** 6.6 lbs. **DIMENSIONS:** 8" x 3" x 8½". **BATTERY:** 12 volts D.C. Negative ground. **POWER CONSUMPTION:** 1.5 amps at 12 volts. **COMPLEMENT:** 15 transistors. **OUTPUT POWER:** 4.5 watts (max) per channel. Specially designed speakers available as optional extra.



Enquire now about fine Tempo equipment and see how little it costs to have truly fine stereo quality in your home and car.

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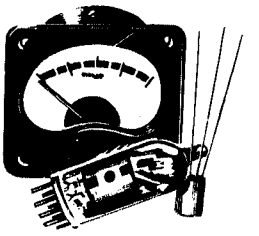

CHAPTER 25: Television. Basic concepts. The elemental area. Scanning. Electronic scanning. Deflection systems. Interlaced scanning. Synchronisation. Vertical and horizontal pulses. Sync. separation. Camera tubes. Iconoscope, Image Orthicon, Vidicon, Plumbicon. TV standards. Number of elemental areas. Bandwidth.

No discussion of "radio" would be complete without at least a mention of television. Unfortunately, a complete and detailed description of modern TV systems would require as much space as we have devoted to our entire radio course, so the best we can hope to do in a couple of chapters is to put the student on nodding terms with the subject. This will at least prepare him for more serious studies.

Perhaps the best place to start such a discussion is with the TV image itself — the form it takes and the reasons why the eye is able to accept it.

Consider the eye first. It has two characteristics which make TV possible; both already exploited in other spheres. Probably the best known is "persistence of vision" — the fact that the eye retains the image of a scene for about 1/16 second after the scene itself has been removed.

It is this fact that makes motion pictures possible in the form we know them, since it enables a series of still pictures, presented in quick succession, to appear as a continuous picture, with small differences between them appearing as movement. In practice, motion pictures use anything from 16 pictures (frames) per second for amateur systems to 30 frames per second for some of the more elaborate wide screen theatre systems. More conventional theatre systems use 24 frames per second.

The other characteristic which we credit, in broad terms, to the eye is its ability to accept, as a complete picture, an image which is, in reality, composed of a number of small discrete areas. A classic example is the "half tone" reproduction of a photograph in a newspaper or magazine. Since the printer has no way of presenting actual tones between the white of the paper and the black of the ink, he resorts to the trick of breaking grey areas into patterns of tiny black dots, their size relative to the surrounding white areas determining the shade of grey. The eye accepts this as a complete picture.

In part, this reaction is undoubtedly due to the simple physiological fact that the eye cannot resolve detail below a certain minimum size. Thus if we view any reproduction at a sufficient distance the eye simply cannot resolve the defects and the viewer is therefore not conscious of them.

However, this is not a complete explanation. The fact is that the impression of a recognisable image, complete with varying shades of grey, is retained even when the dot structure is coarse enough to be clearly visible. This suggests that there is a psychological basis for this phenomenon, whereby the mind "fills in" the missing detail.

In any case, and whatever the reasons, the fact remains that the "eye" is remarkably accommodating in this regard. It is this fact that makes the TV image as acceptable as it is.

Now let us consider how the TV image is constructed.

In order to transmit an image from one place to another, electronically, it is necessary to divide the image into a large number of discrete areas (much like the dots in the newspaper reproduction discussed above), measure the light value of each area, and convert this to an electrical signal suitable for transmission to the distant point. At the distant point the process is reversed. The signal is used to generate light which has a similar value to that of the original image area it represents.

Figure 1. An elementary scanning pattern. The solid lines represent the scanning movement, the dotted lines the retrace action. The distance between the lines is exaggerated to simplify the drawing.

Assuming that we make the discrete areas small enough and re-assemble them all in the right order at the distant point, the eye will accept the presentation as that of a complete picture. We do not even need to present all the areas at the same instant. Assuming that we can present them rapidly enough, such that they are all presented in about 1/16 second, we can present them one at a time and the eye's persistence of vision will retain them all and form a complete picture.

This is important, because it would be impractical to provide a separate circuit between each ELEMENTAL AREA at the transmitter and its opposite number at the receiver. On the other hand, it is relatively easy to interrogate each elemental area on a sequential basis, transmit the information it contains, then move on to the next one and repeat the process. When the last element in the picture has been interrogated, the system starts all over again with the first element and transmits another complete picture. Again assuming that this can be done at 1/16 second — or faster —the eye will not only see a continuous picture, but will be able to observe any movement that occurs

This, then, is the broad basic principle of television; divide the image into elemental areas, interrogate or SCAN each area sequentially, convert its light value to an electrical signal, transmit the signal to the distant point, convert it back to light, and re-assemble each elemental area in its correct relative position. Do this at least 16 times a second and the eye will see a continuous moving image.

So much for the broad picture. How do we achieve all this in practice? How do we scan the elemental areas? How do we convert light into electricity and back to light again? How do we keep the receiver scanning in step with the transmitter? What are the practical standards of modern TV systems?

Scanning an image for TV transmission has been tackled in many ways, including a wide variety of relatively crude mechanical systems used by early experimenters. While we are not interested in the mechanical details of these systems, the broad principles they employed may prove helpful in explaining the scanning concept. (Figure 1.)

As a simple explanation, let us suppose our subject is a large two-dimensional object, such as a poster or sign. And let us further suppose, that, for the moment, we are not interested in transmitting movement.

Facing the poster we set up a bank of photo-electric cells. There are many forms of these, but they all perform a similar function—the conversion of light into an electrical signal approximately proportional to the light intensity. Some cells do this by actually generating electrical energy from the light energy. Others vary their resistance and so control an external source of energy.

We start with the poster in near-dark conditions so that little or no light is reflected from it on to the cells. Then we take a concentrated light source, such as a spotlight or sharply focused torch, and shine a small spot of light on the top left corner of the poster.

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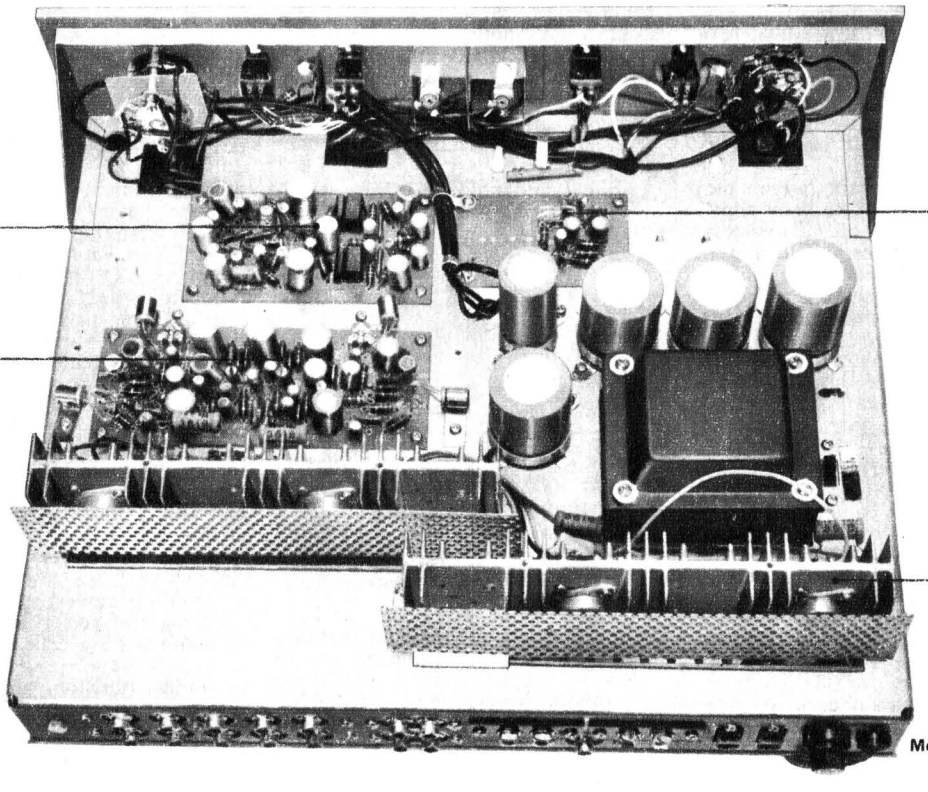

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The size of the spot constitutes our elemental area and the smaller we can make it the more detail we will be able to transmit to the distant point.

From the top left corner we move the beam to the right at a steady rate, keeping it parallel to the top edge. As we do so, the light reflected into the photo-cells will vary according to the pattern of the poster. Where it is white the cells will receive the maximum amount of light, where it is black a minimum and, for intermediate tones appropriate amounts of light. These variations will be converted into similar variations of current and transmitted to the distant point.

When the light spot reaches the top right hand corner it is flicked quickly back to the left hand side and, at the same time, downwards by the diameter of the spot. It now traces a second line, parallel to the first, with the top of the new line just touching the bottom of the previous one. Thus, another line of information is transmitted to the distant point.

This line-by-line analysis continues until the last line is traced at the bottom of the poster and the spot reaches the bottom right hand corner. Then it is flicked back to the top left corner again and the whole process repeated.

As a receiver, we might envisage a similar spotlight, arranged to illuminate a screen and scan it in exact unison with the one at the transmitter. The signals from the photo-cells, suitably amplified, would be used to control the light intensity. Provided the whole process was completed within about 1/16 second, the eye would see a complete picture.

Although we selected a poster as a simple subject to explain the process, this system could be used — and, in fact, was used in early experiments — to televise conventional scenes and objects, including people. Movement is portrayed almost automatically, once we transmit successive pictures with sufficient rapidity to present a continuous image.

A serious objection to this scheme is that it can be used only where the lighting is under complete control, as in a studio. It cannot be used for outdoor scenes where the natural lighting is high, since the cells are unable to differentiate between the ambient light and the scanning beam.

The obvious need, therefore, is for some scheme whereby the image can be collected by a lens and projected on to a suitable scanning device located at its focal plane (i.e., the position the film would occupy in a conventional camera). Early experimenters made many attempts to produce such a camera, using mechanical scanning systems, but they met with only limited success. It was not until the development of electronic scanning, and its application to the TV camera, that any degree of success was achieved.

In passing, it is interesting to note that a completely electronic scanning system for "Distant Electric Vision" was suggested by the English scientist, A. A. Campbell-Swinton, as early as 1908 and again in 1911 in greater detail.

Since electronic scanning is the basis for all modern TV systems, it is worth considering in some detail. Those who are familiar with the oscilloscope will be well on the way to understanding the basic principles, and may with advantage refer to Chapter 16 for a brief refresher.

Electronic scanning, at both transmitter and receiver, uses modified versions of the simple cathode-ray tube used in oscilloscopes. An ordinary cathode ray tube is normally made of glass, is roughly conical in shape, and has a screen of fluorescent material at the larger end. At the small end, and directed towards the screen, is a heated cathode wich produces a copious stream of electrons from its hot surface, in exactly the same manner as a valve. (See Chapter 6.)

By means of an electrode assembly known as a gun the electrons are concentrated into a narrow beam and directed towards the screen at quite high velocity. By varying the voltages applied to the gun the beam may be focused to a fine point by the time it reaches the screen. It would normally strike the centre of the screen unless otherwise deflected. (Figue 2.)

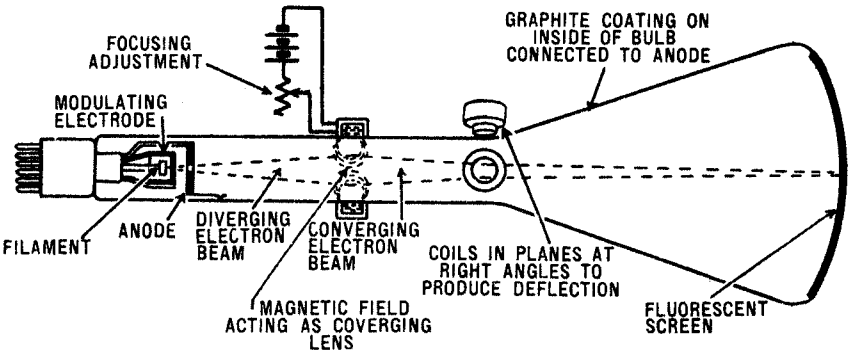

Figure 2. A cathode ray tube. As shown it is fitted for magnetic deflection and focus, but electrostatic focusing is often employed. In practice the deflection coils are larger and combined into a single unit called a yoke. A receiver picture tube has a much larger screen and is much shorter relatively.

When the beam strikes the fluorescent material it causes the latter to emit light, the brightness depending on the rate at which the electrons reach the screen, and the colour on the material from which the screen is made. Almost any colour, or white, can be produced by suitable mixtures of screen materials.

To make use of this electron beam some means must be provided to deflect it to any part of the screen. In the smaller cathode ray tubes, such as used in instruments, the deflection system is built into the tube. Between the gun and screen are two pairs of deflection plates, one nominally horizontal the other vertical.

If a voltage difference is applied to either pair of plates, the beam will be deflected towards the positive plate. Thus the vertical plates will deflect the beam horizontally, and the horizontal plates will deflect vertically. To avoid confusion, the plates are usually referred to as "horizontally deflecting" and "vertically deflecting." This method of deflection is known as electrostatic, and is most useful in small tubes used in conventional oscilloscopes. It was employed in early TV systems, and still is to a limited extent, but has been almost entirely superseded by MAGNETIC DEFLECTION.

Magnetic deflection employs deflection coils mounted outside the tube and through which are passed suitable deflection currents. The magnetic fields which they produce deflect the electron beam. A complete deflection coil assembly is commonly called a DEFLECTION YOKE. Magnetic deflection has a number of advantages, particularly where large picture tubes are concerned.

In addition to the various focusing and deflecting electrodes, the tube is fitted with a control grid which functions in almost exactly the same way as its counterpart in a valve. Thus, by applying suitable values of negative voltage (relative to the cathode) the electron stream intensity may be reduced or even cut off completely, thereby varying the light intensity on the screen in a similar manner. This characteristic of the tube is most useful at the receiving end of the system.

By generating suitable voltage or current waveforms, called SAWTOOTH waveforms, and applying them to the deflection plates or coils, we can cause the electron beam to trace out a pattern similar to the one we described using a spotlight. The advantage of the electron beam over the light beam is that the electron beam may be deflected virtually instantaneously. The light beam, by comparison, can only be deflected by moving relatively heavy optical elements, thus severely limiting the speed with which we may scan our picture. Alternatively, we would need prohibitively bulky and expensive mechanical systems.

Two sets of deflection signals are needed to produce the pattern we require. One set operates at relatively high frequency and is applied to the horizontal deflection components. This causes the beam to move from left to right across the screen at a steady rate, then return almost instantaneously to the left hand side and repeat the steady sweep. At the same time a lower frequency signal is applied to the vertical deflection components so that the beam is moved down the screen.

By suitably relating the two frequencies the beam is moved downward at a rate which allows the horizontal movement to trace out a series of lines one below the other. When the bottom of the screen is reached, both deflection systems return it quickly to the top left corner and the process is repeated. The pattern which is traced in this manner is called a RASTER.

In the Australian TV system, 25 complete rasters are traced out every second and a complete raster is known as a

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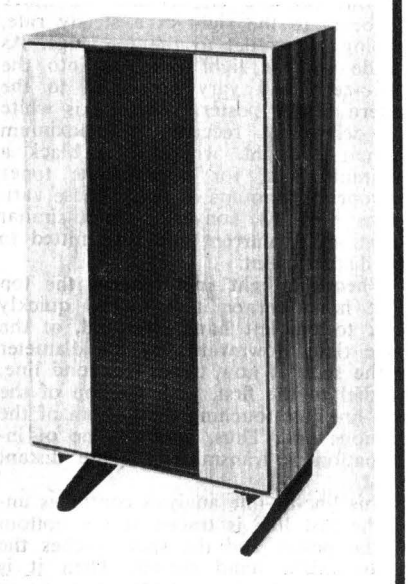

THE KEF "CONCORD," reviewed in Hi-Fi News March '67

In his review, R. L. West, most probably the most highly regarded speaker authority in England, says: "At the first moment of switching on, one realised it was an OUTSTANDING SPEAKER. Things felt real and alive, even at low levels . . . It was a pleasure to listen to the many tapes and B.B.C. programmes and hear really clearly once again . . . Listening is entirely without fatigue . . . Over a long period of listening nothing ever seemed to catch it out . . . The reviewer was so intrigued, that it was compared against a large number of speakers and the original judgement was not shaken in the least . . . Non-compromise response down to 45-50 Hz and still useful down to 30 Hz."
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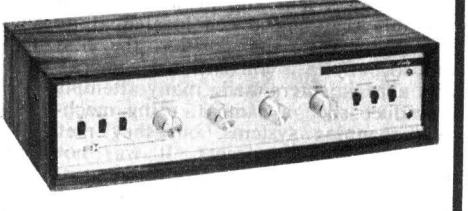

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picture. This figure of 25 is higher than the minimum figure of 16 suggested earlier, and is necessary to minimise flicker. It is also close enough to the normal motion picture rate (24 pictures per second) to enable films to be scanned directly at 25 pictures with negligible difference to the rate of movement or pitch of sound.

But a presentation rate of 25 pictures per second is not sufficient in itself to reduce flicker to an acceptable level. This problem is not peculiar to television; it is also encountered in motion pictures. In the latter case it is overcome by a simple modification to the shutter, whereby each picture is presented twice, thus presenting the eye with a 48Hz flicker rate rather than one of 24.

In TV systems the problem is overcome by a technique called INTERLACED SCANNING, which is a variation of the simple scanning process already discussed. In simple scanning we assumed that the lines would be scanned in logical sequence, 1, 2, 3, 4, etc., starting from the top of the picture. In the interlaced system we scan all the odd numbered lines first, i.e., 1, 3, 5, 7, etc., then return to the top of the picture and scan the even lines, 2, 4, 6, 8, etc. Either one of these scans is called a FIELD. (Figure 3.)

Thus we fill the screen with half the total light 50 times a second, rather than the total light 25 times a second. As far as the eye is concerned, it reacts almost exactly as if we had presented 50 complete pictures per second, rather than only 50 fields. At the same time we avoid the serious bandwidth complications which could result from trying to present 50 complete pictures per second. (What is meant by "bandwidth?" We shall explain the term a little later.)

The interlace function is not as difficult to provide as might be imagined, and is mainly a matter of selecting suitable transmission standards. One of these is the vertical scanning rate, which must be double the rate of complete pictures to be presented per second. Thus, to present 25 complete pictures per second we scan the picture vertically 50 times per second. The other requirement is that the number of lines per picture must always be an odd number, regardless of the actual standard selected (e.g., 405, 441, 525, 625, 819).

The odd number of lines means that each field will involve an odd half line, i.e., for the 625 line system each field will consist of 312½ lines. The time needed to scan half a line is also the time needed for the vertical scan to move downward by half the distance between the previously scanned lines, say the first and third. Thus the second field interlaces the first field automatically.

So far all our references to scanning techniques have simply assumed that we can provide some means of keeping the scanning system at the receiver in step with the one at the transmitter, without offering any explanation. This process is called SYNCHRONISATION or, more commonly, SYNC. We will now consider this in more detail.

Synchronisation is achieved in practice by transmitting a regular pattern of pulses, called SYNC. PULSES, along with the picture information. Success of the system is based on the assumption that the receiver deflection circuits can quite easily be adjusted to run at approximately the frequency required and that this is all that is required if the pulses from the transmitter can be used to provide the final frequency correction and to adjust the phase. (Figure 4.)

There are two sets of sync. pulses, one for each of the deflection oscillators. To control the horizontal oscillator, a single narrow pulse is transmitted at the end of every line. This "instructs" the scanning oscillator to return the beam to the left hand side of the raster (RETRACE) and commence tracing a new line. During the retrace and scanning period the deflection oscillator is "running free," and subject only to its own frequency determining components.

To control the vertical oscillator a series of pulses are transmitted at the end of each field. They are broader than the line pulses and grouped close together, which enables the system to distinguish them from the line pulses. It does this by INTEGRATING (adding together) the pulses to make one large pulse, which then serves to "instruct" the vertical oscillator to retrace to the top of the raster and commence a new downward scan. As with the horizontal oscillator, the vertical oscillator "runs free" after being triggered by the sync. pulse.

The times during which the pulses appear at the end of each line and each field are called BLANKING PERIODS, and no picture, or VIDEO, information is transmitted during this time. The blanking periods appear as a black border around the picture. Thus by reason of their position, in time, the sync. pulses do not interfere with the picture information.

However, the reverse is not automatically true, and it is conceivable that video information could be "seen" by the synchronising circuits and mistaken for sync. pulses. This is overcome by presenting the video and sync. pulses at different levels. In the Australian, system, and most others, a peak white signal is represented by about 12 p.c. modulation, peak black by about 75 p.c. modulation, while the sync. pulses occupy the "blacker - than - black" region between 75 p.c. and 100 p.c. modulation. In the receiver, it is relatively easy to provide a circuit which will not respond to any signals lower than 75 p.c. but responds quite readily to values above this. Thus the sync. pluses are effectively separated from the video signal. This circuit is called a SYNC. SEPARATOR.

At this point, with our scanning and synchronising systems all nicely worked out, the reader may fairly ask how we use an electron beam to scan the image

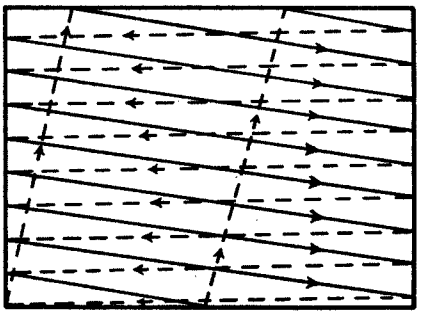


Figure 3. The pattern of interlaced scanning. Compare this with the pattern on page 61.

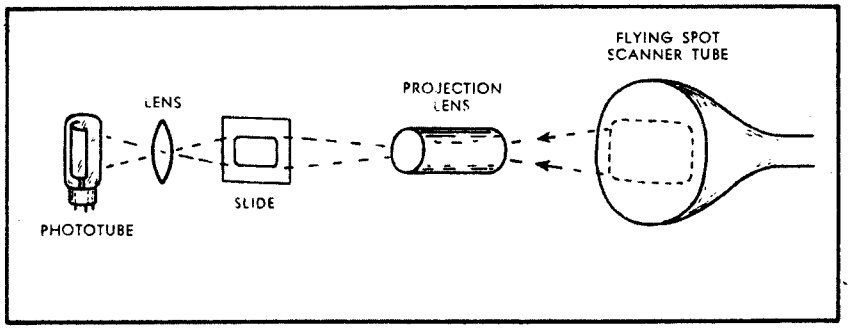
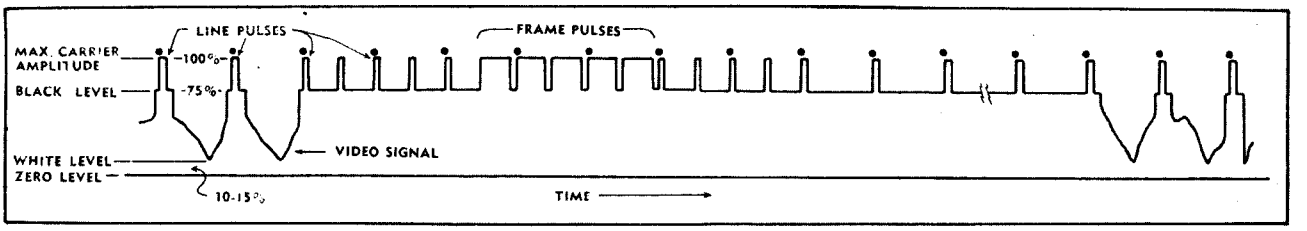


Figure 5. A simple form of electronic scanning. A raster traced on the tube face is focused on to a transparency and then on to a photoelectric cell. Output from the cell becomes the video information.

Figure 4. The relationship between video signal, line pulses and frame pulses. The five broad frame pulses are intergrated into one large pulse, while the spaces between them keep the line oscillator in step.



at the transmitter. One simple way is to use what is called a flying spot scanner, which has valuable, though limited, practical applications. In this arrangement the electron beam traces the raster on a fluorescent screen, exactly as in conventional cathode ray tubes. The screen is located behind a transparency of the image to be transmitted, and a photo-electric cell is placed in front of it. Thus the cell registers the amount of light passing through the transparency as each part is scanned, and the cell output becomes the video signal. (Figure 5.)

Naturally, this arrangement is limited to material which can be presented in transparency form and is of no value for "live" images collected by a lens. To scan these we need a very much more complex tube. A number of these have been developed, such as the ICONOSCOPE, the IMAGE ORTHICON, the VIDICON, and the PLUMBICON. It would be impossible to deal with all these basic types, and the variations on them, in a short article like this. However, a brief description of two of them may prove helpful.

A basic item in most picture tubes is an electrode which is referred to variously as a PHOTO-CATHODE, a MOSAIC SCREEN, a SIGNAL PLATE, or a TARGET. It commonly takes the form of a mica sheet several square inches in area and about .001in thick. One side is coated with a continuous film of metallic silver. On the other side are deposited countless particles of metallic silver which are oxidised and made light sensitive by treatment with caesium. The particles are quite separate and insulated from each other. (Figure 6.)

There is obviously a certain capacitance between each particle and the back plate, so that the mosaic, in effect, can be regarded as an assembly of countless tiny capacitors, with one common plate, and every other plate photo-sensitive. Under the influence of light, a potential difference tends to build up between each of the silver particles and the back plate. If an image is projected on to the photo-cathode by ordinary optical means, the individual tiny capacitors tend to acquire a charge proportional to the light and shade of the picture.

The function of the tube is to scan these tiny charges, converting them into picture signals.

One of the earliest form of picture tube was known in America as the "Iconoscope" and, in England as the "Emitron." (Figure 7.)

The photo-cathode is mounted in the main body of the tube. The scene to be televised is focused through an ordinary lens system on to the light sensitive surface. Under the influence of the light and shade, the tiny silver particles emit electrons and begin to acquire a positive charge. The charge continues to build up, according to the incident light, until it is ultimately released by the electron beam.

It is important to note that light falls on the photo-cathode all the time, and that the charging process by the minute capacitors is likewise continuous.

When the charge is ultimately released, it is quite substantial as a result, and this makes an important contribution to the sensitivity of the Iconoscope or Emitron.

Scanning is achieved by means of an electron beam generated in the neck of the tube. This beam is made to scan the surface of the mosaic, line by line in the manner already described. The precise effect of the electron beam on each tiny capacitor is rather complex, and a detailed examination is hardly warranted at this juncture. Sufficient to say that electrons from the beam replace those which have been emitted as a result of the photo-electric effect and discharge the tiny capacitors as it passes across them.

The resulting change in potential is naturally communicated to the common back plate and a voltage is generated across the load resistor "R." This is subsequently amplified, becoming the picture signal which modulates the transmitter. Primary and secondary electrons released from the photo-cathode are collected by a ring or metallic coating inside the body of the tube.

The most popular modern tube is the Image Orthicon. It has always been highly regarded, and the very latest versions are capable of superb results.

Physically the Image Orthicon looks rather like a projection display tube, being about 15 inches long and about four and a half inches in diameter at the head. It employs a single photo-cathode like the Iconoscope of Emitron, but transparent to light.

The basic principles are illustrated in figure 8.

Electrically, the Image Orthicon is divided into three distinct sections, an image compartment, a scanning section and an electron multiplier.

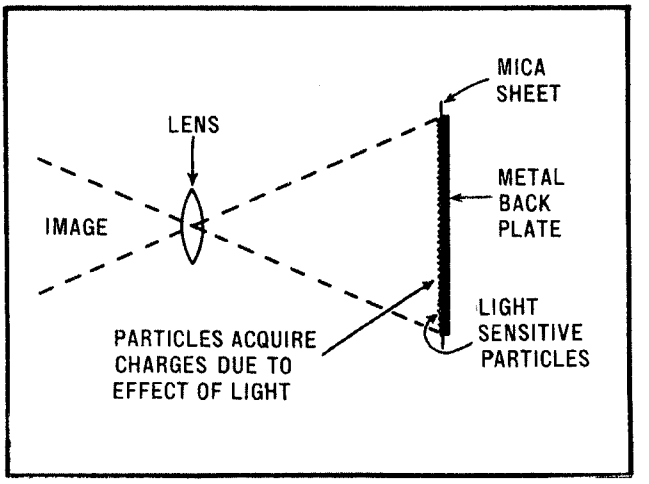


Figure 6. The heart of all camera tubes is some form of photo-sensitive mosaic. Each photo-sensitive element is small by comparison with an elemental area in typical systems.

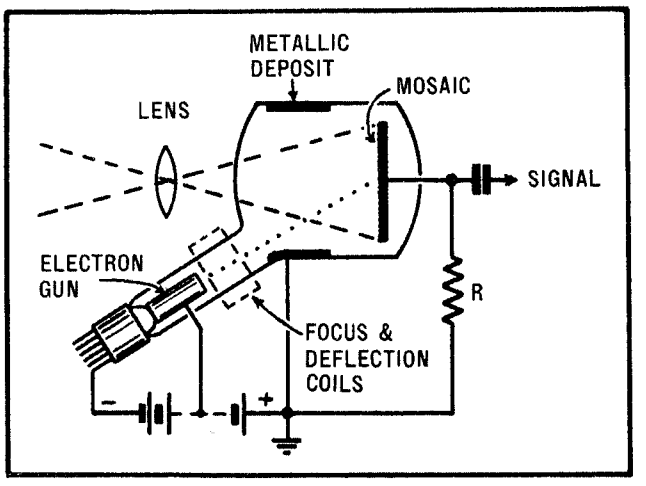


Figure 7. One of the first practical camera tubes, the Iconoscope. Note the angle of the electron gun which presented both optical and mechanical problems.

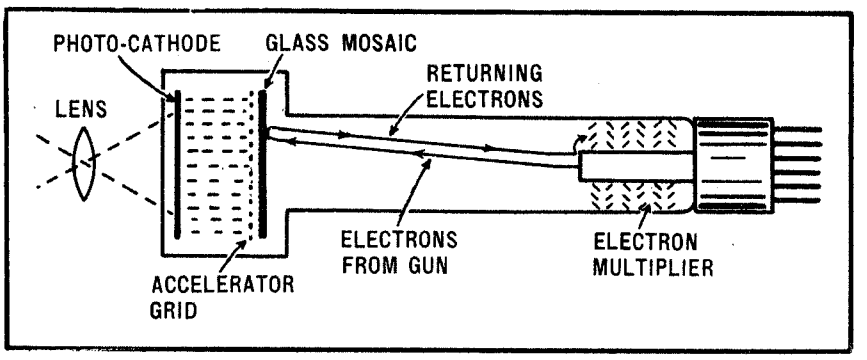


Figure 8. A simplified drawing of the Image Orthicon, one of the most popular camera tubes currently in use. Note the "in line" construction, which simplifies mechanical and optical design.

Light rays from the image are focused on to the transparent photosensitive mosaic. Electrons are emitted from the inner surface in proportion to the light and shade of the image. These primary electrons are accelerated away from the photocathode by an anode structure, and an extremely fine mesh-like grid, which carries a positive potential. The electrons pass through it at relatively high velocity and strike a second mosaic having high secondary emissive qualities.

The base for this second mosaic is actually a film of glass one-tenth of 1 mil. thick. It is so fine that it is transparent to electrons and the charges which accumulate on the front can influence or be influenced by electrons from an electron gun at the rear. When electrons strike the front of the glass screen they create on it an electron image, equivalent in density to the visual image on the photocathode. The impact of these primary electrons causes secondary emission, and individual particles of the mosaic acquire varying positive charges as a result.

The rear of the glass target is scanned by a low velocity electron beam, the electrons being slowed down just before they reach the rear surface. The beam gives up just enough electrons to neutralise the positive charges at each point of the mosaic, and the remainder of the electrons immediately reverse direction and return to a structure surrounding the gun. This structure is actually a form of electron multiplier which greatly amplifies the variations in electron current from the target.

The Image Orthicon combines the outstanding features of all previous tubes and the result is a tube of high sensitivity and small size. The Image Orthicon also puts the gun, the mosaic and the image all on the same axis and eliminates the need for the obliquely mounted neck, as in the Iconoscope and Emitron. It avoids problems with trapezium distortion, clears the lens mount and makes possible the use of a lens turret.

Another type of tube in common use is the Vidicon. This is normally a small tube, about 1in diameter, and is used extensively where the physically small camera and lens with which it can be used are of greater importance than some other factors. It also has the advantage of low first cost and relatively long life. On the debit side it suffers from limited definition and sensitivity and a tendency under low light conditions to retain an image for longer than is desirable, giving rise to smear on rapidly moving objects.

In spite of these disadvantages it has found use in industrial and educational applications as well as in TV stations, where it is useful for presenting captions, films, etc. A more recent version of this tube, called the Plumbicon, has eliminated a lot of the Vidicon problems, and is currently finding a wide application, particularly in colour cameras.

Now that we have learned something of the practical aspects of scanning and camera tubes we are in a better position to consider typical standards as used in modern TV systems. Earlier, we introduced the "elemental area" concept. It is important to retain this concept, even though the subsequent discussion may have placed more emphasis on "lines" than "areas."

The number of lines in a (horizontally scanned) picture determines the vertical resolution only. Horizontal definition is a function of how many transitions from black to white can be accommodated in a single line. As a rough approximation we may consider that, for a square picture, we need as many elemental areas per line as there are lines in the whole picture.

As an example, consider Australia's 625 line system. Allowing for lines lost during the blanking period at the end of each frame, we have about 590 actual lines in each picture. Since the picture is wider than it is high by the ratio 4:3 we should provide 590 x 4:3, or about 790, elemental areas in each line. Multiplying this by the 590 lines we get about 460,000 elemental areas per picture.

What governs the number of elemental areas which we can provide in one line? In simple terms it is a function of how rapidly we are able to switch the picture tube electron beam on or off representing an abrupt transition from black to white. The electron beam itself will respond at almost any speed we like to nominate, the real limitation being the signal we apply to it. This, in turn, is limited by the high frequency response, or BANDWIDTH, of the entire system.

In the example just cited we have 460,000 elemental areas in one picture, which we must transmit completely 25 times a second. Thus we have to transmit 460,000 x 25, or about 11.5 million, elemental areas each second. If we consider the extreme case where adjacent elemental areas are alternately black and white it can be shown that we can transmit two elemental areas per cycle of video signal. So, to transmit 11.5 million elemental areas per second we would need to transmit 5.75 million cycles per second (5.75 million Hz or 5.75MHz).

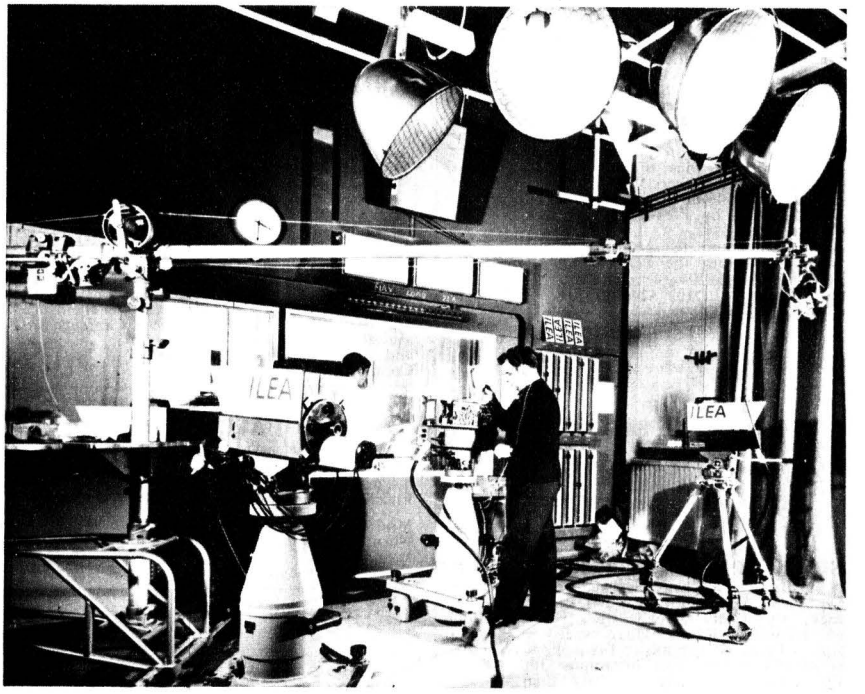
Transmitting a signal of this kind presents a number of problems. First we have to provide a carrier frequency high enough to accommodate such an order of modulation, which must be at least several times the modulating frequency. This fact, plus the space which such a signal must occupy, automatically dictates nothing less than the VHF bands, from about 50MHz to 300MHz. Even here spectrum space is precious, and every effort is made to reduce the needs of the TV transmitter as much as possible.

One trick is to employ a form of single sideband transmission (VESTIGIAL SIDEBAND), where as much as possible of one sideband is suppressed. Another is to accept some compromise between the number of elemental areas we would like to transmit and the minimum number which will noticeably degrade the picture. In the Australian system we provide a total bandwidth of 7MHz for each TV channel, which has also to accommodate the sound channel.

Within this we provide a video bandwidth of about 5MHz, which is only a little less than the theoretical ideal. However, this order of performance is seldom matched by the receiver, which would be regarded as quite good if its bandwidth extended to 4MHz. Nevertheless, the end result from a good TV set can be very satisfying if the original material is good.

Other systems vary from this standard. The American 525 line system has both less lines and less elemental areas, so must be regarded as marginally inferior, even though this may not be really serious in practice. On the other hand, some European 625 line systems are better than the Australian system, in that they provide a greater bandwidth and therefore come closer to reproducing an ideal number of elemental areas.

This covers most aspects of TV transmission and is all we can discuss in this chapter. In the next chapter we will decribe the other end of the link, the receiver. ■



Modern television systems play many roles apart from entertainment. Industry, research, medicine and education all make extensive use of this facility. The picture shows a studio belonging to Britain's Educational Television Service, designed to serve 1,300 centres in inner London.

TRUVOX R102 ($226) AND R104 ($236) TWO AND FOUR TRACK MONO RECORDERS

Featuring three heads, three motors and three speeds, the Models R102 and R104 have been very favourably reviewed overseas. Frequency response at 7½ i.p.s. is 30-17,000 Hz., plus or minus 2 db. Separate record and play-back amplifiers. VU meter. Write for complete specifications and copies of reviews R-104 **$236**

TRUVOX STEREO TAPE UNITS MODELS PD 102 and PD 104

With four independent pre-amplifiers, complete mono and stereo monitoring facilities are provided on the new TRUVOX PD-102 and PD-104. Twin VU meters. Mixing buttons for sound on sound. Separate solid state record and playback amplifiers. Three motors, including papst drive motor, three speeds. Sensitivities match any ancillary equipment of any make. Frequency response — 30-17,000 Hz at 7½ i.p.s. — plus or minus 2 db. Signal to noise is better than 50 db. Input sens. are . . . Microphone — 1 mV at 50k ohms, Radio Tuner or Pick-up — 50 mV at 100k ohms.
Write for complete specifications and copies of reviews; both the PD 102 (2 track) and PD 104 (4 track) are now in stock PD102 **$246** PD104 **$236**

TRUVOX R44 SEMI-PROFESSIONAL RECORDER

A brilliant new fully transistorised recorder for 240V AC operation. All controls interlock, VU meter provides positive indication of recording level. Three speeds, 7½-3¾-1⅞ i.p.s. Takes 7" spools. Frequency response is 40-15,000 Hz, plus or minus 3db. at 7½ i.p.s. Signal to noise is better than 46 db. Output is conservatively rated at 3 watts R.M.S. (6 watts peak) into a 15 ohm load. Wow and flutter is less than 0.15% at 7½ i.p.s. Independent microphone and radio/pick-up controls are standard—full mixing is hereby simplified. Eleven transistors and two rectifiers. See the review in "Amateur Tape Recording", Oct., 66, and "Audio and Record Review", Aug., 66. **Encel price** **$139**

NOW AVAILABLE . . . TRUVOX TAPE DECKS!

At last the rugged and proven TRUVOX tape decks are available in Australia in mono and stereo, two and four track configuration . . . and Encel prices are most attractive. No longer need you wait to have your tape recorder . . . look at these prices! These decks are **identical** to those used in the models R102-4, PD102-4.

D102 two track mono	**$89**
D104 four track mono ..... Replays stereo tapes	**$89**
D106 two track stereo	**$99**
D108 four track stereo	**$99**

GET THE ENCEL FACTS

Pamphlets and technical specifications are usually available for most Encel merchandise. Write or call for further information.

NEW KELLY 15" WOOFER SPEAKER (Mk. VII)

Rated at 50 watts, the frequency response of this new bass reproducer is 30-5000 Hz. Total flux is 350,000 maxwells. Recommended crossover frequency is 2500 Hz. (The Kelly Crossover costs **$11**). The Mk. VII uses a laminated aluminium former with the voice coil embedded in polyester resin. Guitar models also available **at the same price** **$59.50**

THE MK. II KELLY RIBBON TWEETER

Regarded as the most effective and advanced tweeter available for domestic speaker systems, the Kelly Mk. II is priced at only **$39**

KELLY ACOUSTIC LENS

Designed for use with the Kelly Mk. II Ribbon Tweeter the Acoustic Lens effectively disperses H.F. radiation **$12.50**

NEW MODEL 12" BASS REPRODUCER FROM DECCA-KELLY . . . THE DK I!

This 12" woofer is the model used in the Kardioid enclosure; total flux is 250,000 maxwells due to use of a new ceramic ring magnet of "Magnadur 2". Frequency response is 30-5000 Hz. and the recommended crossover frequency is 2500 Hz. The voice coil is embedded in polyester resin — transient peaks of 100 watts will not damage the assembly. Normal power rating is 35 watts R.M.S. **Encel price** **$48.50**

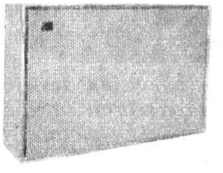
DECCA-KELLY KARDIOID KITS

In order to reduce prices the Kardioid is now available in component form. The Model DK1 bass reproducer, Mk. II Kelly Ribbon Tweeter, Acoustic Lens and Crossover Network are supplied. Detailed construction instructions and illustrations of the enclosure are provided. Total price: $109. Cabinets are available if required — polished and unpolished. Ask for details. Components only **$109**

DUAL TURNTABLES DRASTICALLY REDUCED!

Model 1019 — This popular turnable/tone arm and cartridge combination is normally priced at $139. Encel price is now only **$89.50**

Model 1010A — Automatic record changer. Normal price is $69.80. Now selling at **$52**

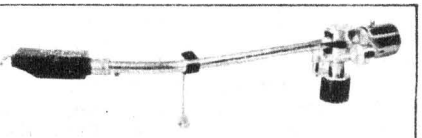


HAND CRAFTED "SONICS" SPEAKER SYSTEMS

A wide range of multiple speaker "Sonics" speaker systems is now available and prices are as low as $19.50. One of the most popular would be the AS-63 which features a bass speaker and a 3" diameter tweeter. Size is 14½" x 9⅝" x 8⅝", finish is oiled teak or walnut and price is only **$39.50**
*Also Models AS-40A $19.50, AS-60 $25. AS-61 $35.50, AS-302 $47.

NEW UNOBTRUSIVE DYNAMIC MICROPHONE

The robust, pint sized dynamic microphone, the Piezo Model DX75, is supplied with a desk stand. Dual impedance is 50 k ohms and 50 ohms. Ideal for tape recorder applications. Exceptional value at **$7.90**
High impedance (50 k) only **$6.90**



MICRO TONE ARMS

Few products have been received by the purchasing public quite as enthusiastically as MICRO tone arms and cartridges . . . performance easily justifies the use of the best available amplifiers and speaker systems. Finish is impeccable — MICRO precision engineering is without equal in this price category. All arms accept standard Ortofon and SME shells; vertical and lateral friction is estimated at less than 20 milligrams. Model MA 88 (16") costs **$35.50** — MA 77 (14") and MA 77S (12") are Encel priced at **$29.50.** Read the reviews in your April '66 copy of "Electronics Australia" . . . and in "Hi-Fi News", February, 1966. Ask for copies of these enthusiastic reports. From **$29.50**

MICRO DUST PICK-UPS

This most effective record cleaner automatically removes dust and static charges as the record is being played **$3.50**

LOW PRICED CERAMIC CARTRIDGE FOR BUDGET CONSCIOUS MUSIC LOVERS!

Now the well known Micro Model SC301 Ceramic Stereo Cartridge with diamond stylus is available for only **$6.90.** Frequency response is 20-15,000 Hz. plus or minus 3 dB Tracking angle is 15°. This popular stereo cartridge is A1 value at **$6.90**

NEW ZENZA BRONICA CAMERAS

The most famous 2¼ squ. reflex cameras in the world would be the Hasselblad and the Zenza Bronica — but only the latter has incomparable Nikkor lens equipment and a focal plane shutter. In consequence supplementary lenses are much lower in price. . . . The new model S2 Bronica has a detachable film back enabling change of film type in a few seconds and is attractively priced at $299 complete with f2.8 75 mm. lens. The model C2 sells at only $245. Both prices include sales tax. Encel Electronics Pty. Ltd. is the Australian Agent for Zenza Bronica. Ask for prices on the multitude of supplementary lenses and accessories. **Encel prices are less than ½ U.K. prices and less than ⅔ U.S. prices for identical cameras.**

Model S2—$299

Model C2—$245

THE NEW ORTOFON S-15 STEREO CARTRIDGE AVAILABLE AT ALL ENCEL STEREO CENTRES!

World wide acclaim provides significant testimony to the outstanding performance of the new S-15. Ask for an EMQ.

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COMPATIBLE SINGLE-SIDEBAND MODULATION --tests over station 4QG

In his "Broadcast Band News" on page 149 of our last issue, Authur Cushen referred to tests on compatible single sideband modulation, conducted on the standby transmitter of station 4QG in Brisbane. The following note by Mr. M. P. Moody, who was responsible for the tests, explains the basis of the system employed.

A research program was undertaken at the University of Queensland to study Compatible Single Sideband Modulation with a view to a practical system which could be adopted to a transmitter for broadcasting. After the initial tests on a model system had proved the feasibility of CSSB broadcasting, an approach was made to the P.M.G. and the A.B.C. requesting their co-operation. These departments readily made available their transmitter and program recording facilities for the tests.

The model CSSB system was modified to enable audio frequencies up to 10KHz to be used, and this was connected to the 4QG standby transmitter as shown in the diagram. The output power of the transmitter is 2KW and its frequency 790KHz.

The CSSB modulator consists essentially of a phase modulator. The phase-modulating signal is derived from the audio signal in such a way that when the **resultant phase-modulated** carrier is amplitude modulated in the usual way, a single-sided spectrum is obtained, which has a bandwidth approximately equal to that of the audio signal. Since a form of amplitude modulation is used, the signal can be detected with an ordinary linear diode envelope detector, and is thus "compatible" with existing broadcast receivers.

The phase modulating system is produced by generating a full-carrier single-sideband signal (which has envelope distortion) then limiting this and detecting its instantaneous phase. This phase signal is then processed and used to phase-modulate the transmitter carrier. The carrier is derived from the transmitter's exciter, and hence is crystal-controlled at the correct frequency. By switching off the phase-modulating signal, an instant changeover from CSSB operation to D.S.B. (double sideband) operation can be achieved.

The on-air tests were designed to compare the quality of reception of DSB and CSSB. Since the envelope is imposed in both cases by the same amplitude modulator, they are identical and exact. The only difference in the transmitted signals is their spectra. A difference in reception quality will occur however, due to the influence of the receiver filters in the RF and IF stages.

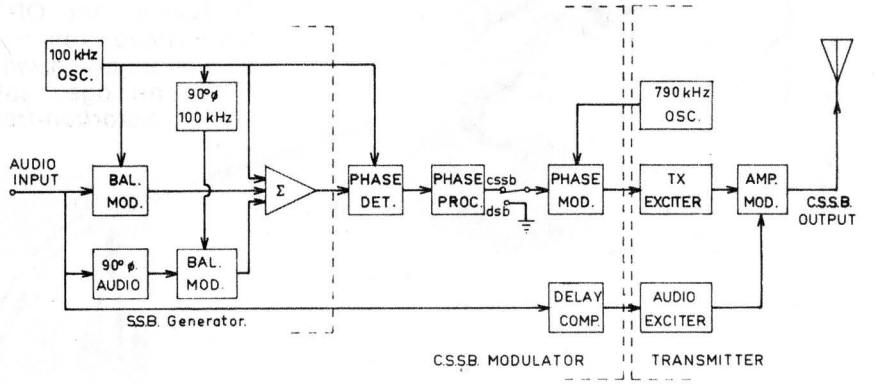
Two different effects occur. Since most commercial radios have IF bandwidths of about 10KHz, only 5KHz audio will be received using DSB. However, with CSSB, since the bandwidth is approximately equal to the audio bandwidth, a receiver with 10KHz IF bandwidth will receive audio frequencies up to 10KHz.

Thus, it is seen that for most receivers, a gain in fidelity is possible with the use of CSSB, with an accompanying increase in the quality of reception. The disadvantage which CSSB exhibits in respect to DSB due to this effect.

Thus there are two effects of the receiver filter, one improving the reception of CSSB compared with DSB, and one degrading it.

Each broadcast consisted of one hour of selected music played after midnight on eight occasions. This hour was split into two separate half-hour tests. In each test, 15 minutes of each type of modulation was transmitted, the listener not knowing the order in which each was used. In this way listener bias was eliminated. The listeners were then invited to choose which part of each test they preferred, and the reasons for choosing it, and in this way an indication of the comparision between the two systems was gained.

The results were very encouraging, and it can be said, with about 95 per cent certainty, that CSSB reception was as good and probably better than DSB reception. With its bandwidth-saving advantage, it thus appears that CSSB could be a worthwhile solution to some of the interference problems being experienced in Australia today. ■



University of Queensland
Compatible Single Sideband System

ORTOFON

WORLD LEADERS IN TONE ARM AND CARTRIDGE TECHNOLOGY!

✳ Over 90% of Australian radio and television stations (and recording studios) have standardised on ORTOFON moving coil pick-ups. Audio engineers with facilities for precise measurement specify ORTOFON; the ORTOFON moving coil system has been proven reliable, predictable and consistent . . . as well as being *inherently more linear*. Only ORTOFON cartridges satisfy professional demands for *stable, distortion-free pick-ups.*

The audio enthusiast seeking the ultimate in high-fidelity reproduction can purchase ORTOFON arms and cartridge with complete confidence for **the most realistic high-fidelity sound originates with ORTOFON.** The new ORTOFON S-15 series cartridge has been acclaimed by critics all over the world. Tracking angle is precisely 15° and the most complex wave form may be traced at 1½ grams stylus pressure; the superbly polished elliptical diamond stylus is fully protected should the cartridge be accidentally dropped to the record surface.

Specifications —

Frequency response: 20-20,000 Hz. ± 2 dB.
Static compliance: 20 x 10^{-6} cm/dyne.
Channel separation: 20-30 dB.
Stylus: 0.0007 x 0.0003 elliptical diamond.
Equivalent mass: 0.9 mg.

The ORTOFON elliptical diamond stylus closely approximates the shape of the original cutting stylus, and will track without distortion due to pinch effect . . . this freedom from distortion being obvious towards the label where pinch effect is always a problem.
Illustrated is the popular SMG-212 tone arm fitted with the "G" shell. ORTOFON tone arms are available in nine models. When the open-front metal "G" shell is used any cartridge may be fitted.
We invite you to listen to ORTOFON today at your favourite hi-fi supplier; listen to the astounding difference!

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Tas.: K. W. McCulloch Pty. Ltd., 109 York Street, Launceston. Tel. 2 5322
A.C.T.: Australian Physical Laboratories. P.O. Box 225. Canberra City. Tel. 4 3010 (Mr. J. E. Howe)
N.T.: Pfitzner's Music House. Smith Street. Darwin. Tel. 3801

Forum

Radioactivity — Tape frequency response

In the brief period which has intervened between the last issue appearing on the streets and the preparation of this present article, there has been no further light on the question raised in Forum under the heading "Cold-cathode tubes —radioactivity hazard?"

Conducted by the Editor

Among the many who have expressed interest in the matter was a reader who took the trouble to ring from interstate. He confirmed that training in the Armed Services laid a good deal of emphasis on the hazards of radioactivity and agreed that this emphasis may well have been responsible for a gross exaggeration of the danger (if any) from radioactivity in small thermionic valves. But while he was apparently inclined to this view, he was certainly far from being sure of himself.

And, from Goondiwindi, Queensland, a correspondent, L.B., writes in the following terms:

Dear Sir,

"I refer to the item 'Radioactivity hazard' in Forum for the June issue. I have read much on this subject. Other hazards are X-ray radiation from operating EHT rectifiers, beta radiation from cathode-ray tubes and poisoning from contact with sulphides from domestic fluorescent tubes.

"My big criticism is that no one has, as far as I know, bothered to give details or symptoms of effects of this type of injury.

"In 1952 I was badly cut by a fluorescent tube and, having read a warning about such an injury, I consulted a doctor. He was as well advised about it as you are!

"In consequence, I developed a skin disease which was diagnosed as psoriasis. However, all agree that it doesn't fit the usual pattern but there is one factor which proves it is psoriasis—it is incurable!

"I feel that there is room for continuation of this article. How about a statement from the Armed Services?"

I reprint this letter even though, in terms of the immediate subject, it contains certain "red herrings." It does, however, relate the subject to human values.

First and foremost, radiation from EHT rectifiers and cathode-ray picture tubes has been the subject of considerable observation and discussion. Nor is it just a question of guesswork or opinion; the strength of such radiations can be measured and evaluated. By those who have done so, there appears to be common agreement that the radiation level from ordinary monochrome television receivers is of such an order, relative to the ambient, that it can pose no likely hazard to anyone, from viewers to TV servicemen alike.

The radiation from colour television receivers is a little higher, by reason of the increased EHT, but still well short of the danger level in domestic situations. Again, this has been the subject of considerable observation and, just recently, certain receivers in the U.S. were recalled for modification—just in case.

As for the alleged connection between a broken fluorescent tube and psoriasis, I am not competent to pass an opinion, or on whether there is a further connection between the substances used and the original subject of radioactivity. It may well be that, in toto, the hazard from a broken fluorescent tube is far greater than from radio valves of any description. A fluorescent tube is certainly larger, more fragile and more liberally coated with fluorescent powders.

To change the subject, I received recently an interesting letter from Mr Harvey Gernsback, publisher of the American magazine "Radio Electronics." The letter is self-explanatory:

Dear Mr Williams,

"In reading the April issue of your always interesting journal, I noted in your department 'The Answer Man Explains' a discussion about the fidelity of long-playing tapes. I missed the original discussion in your January issue.

"There is a small difference in high frequency response between the standard and so-called extra-play tapes, but there is a very marked difference between the response of standard tapes and the triple-length tapes, as you can see from the specification sheets which the 3M Company puts out here in the States. Since their tape specifications are pretty generally followed by other manufacturers, I presume that they probably apply in Australia, too.

"The Scotch brand standard tape is No. 111. Their long playing is either 150 or 190, depending on whether it has an acetate or polyester backing, and their type 200 is a double-length tape. The electrical characteristics of the 150, 190 and 200 are substantially identical and show a high frequency sensitivity approximately 3dB greater than the standard tape. This assumes that the bias of the recorder has been readjusted to optimum bias for these tapes. If the bias is adjusted to the optimum for the 111 tape, the electrical response of the 150, 190 and 200 will be substantially the same as 111.

"On the other hand, with the 290 triple length tape there is an 8dB difference in high frequency sensitivity,

Technical writing

Further to your Editorial, "ELECTRONICS Australia", May, 1967.

The low standard in technical writing is not confined to higher echelon professional engineers.

After multiple attempts at digesting the contents of numerous manufacturers' equipment handbooks, the brainchild of the so-called "Technical Writer," one inevitably reaches the conclusion that the majority of these gentlemen are non-technical and illiterate to boot!

E.W. (Carlton, N.S.W.)

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AND A GREAT INVESTMENT

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A COMPLETE TECHNICAL GUIDE TO M.A.T.V.

(MASTER ANTENNA TELEVISION DISTRIBUTION SYSTEM FOR HOTELS, MOTELS, APARTMENT BUILDINGS, SCHOOLS, HOSPITALS AND DEALER SHOWROOMS.)

M.A.T.V. is big business today. This manual is a thorough guide to Systems Planning. Many charts and actual examples of systems are detailed together with loss factor calculations and a full explanation of trade terms and accessories. Send for this manual. It could open up a new business for you.

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To: FERRIS BROS. PTY. LTD.
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Please forward to me your M.A.T.V. PLANNING MANUAL. I have enclosed $1.00 Cheque (or Postal Note).

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regardless of whether the bias is adjusted for the 111 standard tape or for the 290. According to 3M, the 290 tape was not designed to be used on wide-range equipment but rather was designed for popular priced equipment, and its exaggerated high frequency reponse is supposed to compensate for inadequacies in high frequency response of the cheaper recorders. On a high quality machine it is very difficult, if not impossible, to adjust to flat response with the 290 tape since you tend, as your correspondent suggests, to get a peak response at around 10kHz.

A Younger Reader

From one of our younger readers comes a letter setting out the problems of junior but avid enthusiasts and requesting circuits for devices using battery valves. We quote:

Dear Sir,

"I am aged 13½ and very interested in radio and electronics. In 1965 I entered a project in the Science and Talent Search conducted by the Science Teachers' Association of Victoria. I named the project 'The Development and Construction of My Crystal Set,' and won a prize of $4.

"I have repaired several crystal sets, which were given to me when out of order, and have repaired quite a few electrically operated toys for my friends, also a transistor radio which had a broken resistor and a broken condenser lead.

"But, as a member of a family of eight children I find it hard to buy electronic parts. By saving up for a long time and with dad's help, I managed to get a Philips EE20 kit for Christmas and have had lots of fun with it, and still do.

"But I would like very much to get more gear to work with, so that I can learn about electronics. Sometimes I am lucky enough to collect old battery and AC radios and dad gets me some, too. I have dismantled most of them and saved lots of parts.

"Dad lets me use his Scope soldering iron and multimeter. I am not yet allowed to make any AC mains projects but am allowed to use two Philips battery eliminators, so far only when dad is around — I hope to be 'promoted' later on.

While I have saved all the parts I can, some of them are hard for me to work out. Sometimes valve numbers are rubbed out and the impedances of loudspeakers and transformers are missing. I have no way of testing these items. The manufacturers should brand them properly. Coil kits are a problem, too.

"Besides making up all the projects possible with my Philips kit, some of them many times, I have built a one-valve radio, from your 'Reader Built It' in October, 1956; a Morse-code oscillator from a circuit in a library book; a three-valve radio described in your magazine for February, 1953. All of these used battery valves.

"I have looked all through dad's collection of 'R, TV and H,' and 'ELECTRONICS Australia' magazines from January, 1959, along with odd earlier ones, but I cannot find enough battery valve projects. So I have been looking for them in the Warrnambool Library, but the projects from England do not always give details about the coils. I would like to see more projects in 'ELECTRONICS Australia' for battery valves."

P. R. (Warrnambool, Vic.)

One of the pleasing things about this letter is the natural reference to "Dad." In an era when so many voices are proclaiming a rift between generations, it is refreshing to observe situations where the old-fashioned relationship is maintained.

Again, the young correspondent's struggle to find parts and circuits strikes a familiar chord. In our relaxed moments, Associate Editor Phil Watson and I reminisce occasionally on the way we had to "scrounge," as country schoolchildren—not forgetting those medicine bottles which were "doctored" to become the containers for a battery of Leclanche cells. I wonder how they would go in a modern wall-to-wall home —those bulky generators of volts and green slime?

What happened to all the battery valves and to sets and circuits using them?

Answer: They were abandoned—more swiftly than any other electronic technique that I can recall.

The fact is that valves designed to operate from batteries never were anything but a precarious compromise between performance on the one hand and economy of operation on the other.

With the appearance of transistors and the rapid postwar proliferation of AC power mains designers dropped battery type valves like the proverbial hot potato and the public seemed to discard receivers using them in like manner.

Our readers certainly reflected a complete lack of interest in battery-valve circuits, simply on the basis that they could buy transistors for the same kind of money that they would otherwise spend on batteries.

The question of manufacturers branding individual components in their receivers is an old one and any remarks we might make on the subject are not likely to change the position to any degree.

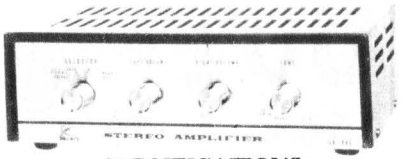
First and foremost, manufacturers don't make their sets to be stripped down and one can hardly blame them if they don't pay too much attention to the desires of people who may later want to use the parts. If there is a point here, the people to consider would be servicemen, who have to identify parts for replacement purposes.

A fundamental fact is that equipment manufacturers do not buy parts "over the counter," identified and/or packaged for individual sale. They order by the hundreds or thousands, and there is usually a definite saving in buying parts packaged in bulk, with a minimum of external coding. Ordinary stock and assembly-line procedures avoid difficulties at the factory and it is only later that problems of identification arise.

Even then, it is much easier for a serviceman to order "Part No. 1234" than to quote a model and serial number and try to identify the component from it that he needs.

In short, while not defending inadequate identification, or type numbers that rub off, we have to point up the difference between parts offered for sale and those used in manufactured equipment.

PALACE 8-WATT STEREO AMPLIFIER



SPECIFICATIONS:

● Output Power: 8 Watts, 4 Watts per channel. ● Frequency Response: 60 to 15,000 cps ± 1db. ● Harmonic Distortion: Less than 3 per cent. ● Hum and Noise: 52 db below rated output. ● Sensitivity: Phono (Crystal) 100mV 250K ohm Tuner 100mV. ● Tube Complements: 12AX7 x 1, 30A5 x 2, 1S315 x 1 (Silicon Rectifier). ● Dimensions: 9¼in x 6¼in x 3in. ● Weight: 5.1lb.

Price $32.50

MODEL M6 FOUR CHANNEL TRANSISTORISED MICROPHONE MIXER

All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

SPECIFICATIONS:

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ● Hum: 0. ● Battery: 9 volts.

Price $6.75

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Complete with batteries and 50ft connecting wire. May be used further apart if desired by using heavier connecting wire.

Colors Available—Ivory, Red and Black

$13.50 Set of two

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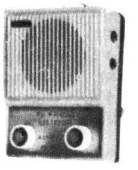

This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

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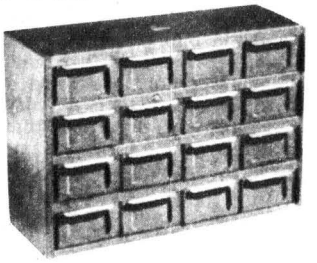
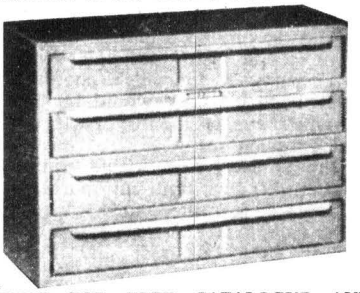
The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.



CHEST OF DRAWERS TYPE C.D.4.

A 17⅛in x 6¾in x 11⅞in Galvanised Chest containing 4 full-length drawers each measuring 15¾in x 6⅝in x 2⅛in. Finished in blue hammertone stoving enamel. **$7.00.**



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40.S	5/32in	0.618in	1/4in		5/16in	$2.17
48.S	3/4in	0.742in	3/8in		5/16in	$2.80
56.S	7/32in	0.884in	1/2in		3/8in	$3.80
64.S	1in	1.008in	—		3/8in	$4.10
72.S	1 1/32in	1.133in	3/4in		3/8in	$4.93
76.S	1/3/16in	1.172in	—		3/8in	$4.93
80.S	1 1/4in	1.258in	—		3/8in	$4.97
88.S	1 3/8in	1.382in	1in		7/16in	$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

96.S	1 1/2in	1.512in	—	9/16in	$6.68
112.S	1 3/4in	1.762in	1 1/4in	9/16in	$7.60
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Philips valve data	Book New Issue	$3.00.

25c postage.

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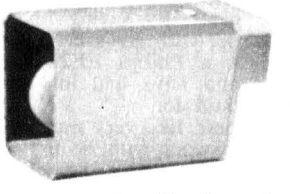

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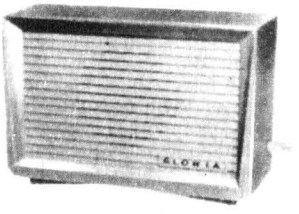

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"NEW LOOK" FOR THE EVER-POPULAR UNIT-4

For over five years, since May, 1962, the "Unit Playmaster No. 4" has been a sales leader among kits—a single unit stereo amplifier with excellent performance, full tone control facilities and a power output of about 10 watts per channel. With minor revision to its controls and its input and output facilities, it can take its place alongside the most modern solid-state equivalents.

By Leo Simpson

Two months ago, when we set about presenting the "All-Silicon Playmaster 115," we made no secret of the fact that its specifications were patterned on those which had proved so popular with the original No. 4 Unit Playmaster; sensitivity to operate from good quality ceramic pickups, full control facilities, good performance, a power output of about 10 watts per channel, straightforward construction and a general economy of design. The 115 met these requirements, within the framework of present-day solid-state techniques, with the option of an in-built preamplifier for low-output magnetic pickup cartridges.

But the release of a solid-state amplifier does not, by any means, indicate that valve amplifiers have "had it." For all practical purposes, the performance figures of the basic No. 4 valve design are the same as those for the solid-state version. It can have the same control and intput/output facilities, will fit into the same size case and can, if necessary, be provided with a similar preamplifier for magnetic pickup cartridges. To be sure, valves aren't quite as modern as transistors, and they operate at higher temperatures but, against this, many enthusiasts will find this amplifier somewhat easier and cheaper to build than the 115 all-silicon design.

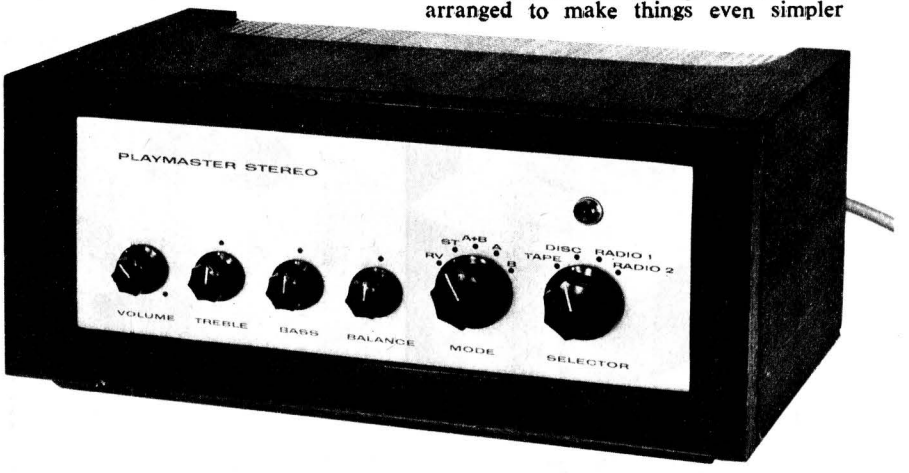
In fact, it is not our purpose to try to "sell" one design or the other. On the contrary, we have quite deliberately arranged for them to be virtually identical in external appearance and performance. Those who are looking for a solid-state design, with its air of modernity, will naturally choose the 115. Others, who may prefer to stay with the techniques they understand better may prefer the new 118, as we have designated the restyled No. 4. The comparative costs will be something for suppliers to work out and advertise, though we expect the valve unit to be the cheaper of the two, at least for the time being.

The restyling is largely a matter of physical arrangement. The old "selector" switch, popular a few years ago, has been replaced by two switches, one to select the signal source and the other to select "mode" — a variation largely prompted by the possible use of amplifiers with mono/stereo tape-recorders. This new control facility, requiring an extra knob, obviously calls for a new panel, the layout being the same as for the 115 and the transistor control unit which preceded it.

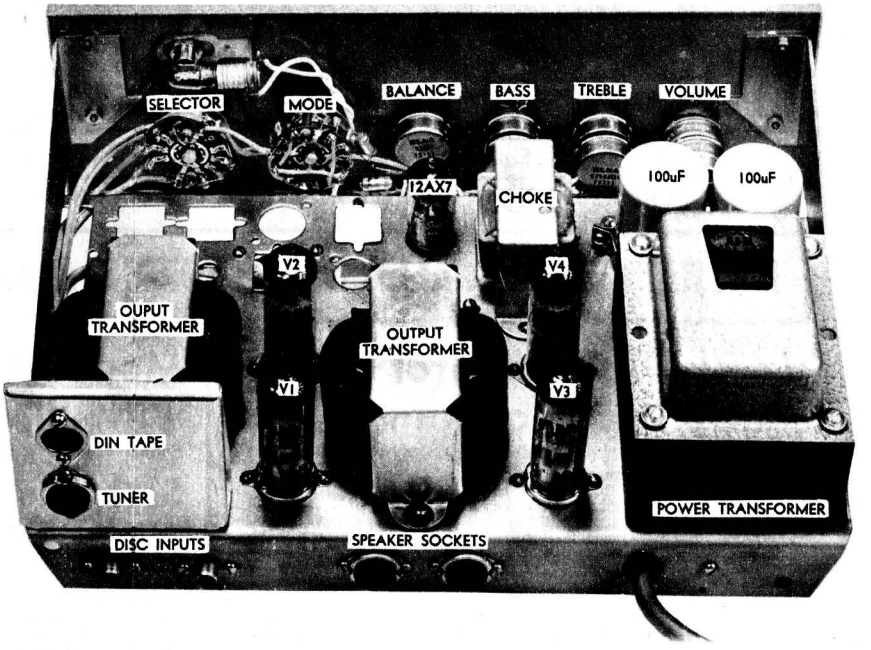
Behind the panel, the components have been laid out on the same chassis as is standard for the 106 Playmaster tuner/amplifier. Use of the same chassis is intended to assist the parts suppliers and the space not used for a tuner is available for a solid-state magnetic pickup preamplifier, should this be required.

At the rear of the chassis, we have rearranged the connection facilities to provide for tape input/output, as well as for pickup and radio tuner.

Underneath, the wiring has been rearranged to make things even simpler



A front view of the new 118 Playmaster, fitted with a full-size panel and housed in a teak case, both available from one of our advertisers. These could be used for the 115 all-silicon unit featured in the May issue, alternatively, the new 118 can as easily be housed in a metal case, the two being quite interchangeable.



A rear view of the 118 Playmaster, constructed in the chassis originally designed for the popular 106 tuner/amplifier. The vertical bracket in the left foreground carries the DIN plugs for radio tuner and tape input/output. Constructors not requiring these facilities may prefer to omit them for the time being, but we suggest that the adjacent output transformer be moved forward slightly—just in case!

MAGRATH'S

Stentorian SPEAKERS

Model H.F. 1016 STENTORIAN
10in P.M. Unit and 16,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 15,000 c.p.s. Bass resonance 35 c.p.s. **$21.00** (including sales tax).

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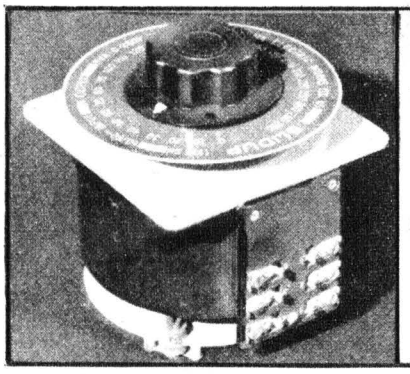

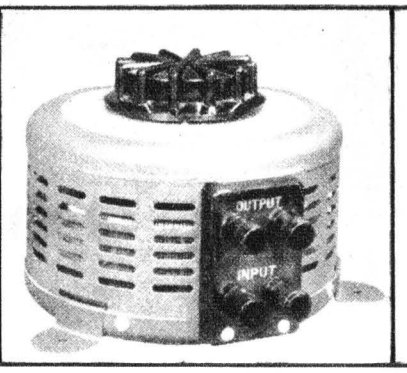

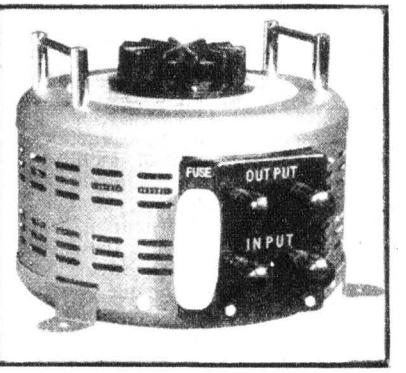

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BP3 "	"	"	1.5 Amps	300	$14.60
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SB5 Bench Mounting	"	"	5.0 Amps	1000	$23.40
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B15 "	"	"	15.0 Amps	3000	$53.10
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Sales Tax where applicable 12½%. (FREIGHT EXTRA!)

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MAGRATH'S FOR ALL "ELECTRONICS Australia" PROJECT KITS

VARI-TACH Motor speed control project kit

Further details—Page 43, March '66 "ELECTRONICS AUSTRALIA"

Using this easily constructed, low-cost unit the speed of a "universal" or communator-type AC motor may be adjusted over a wide range while still maintaining fairly constant torque. Ideal for controlling speed of electric drills, saws, food mixers, projectors, etc.

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Anywhere in Australia and territories.

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Further details—Page 80, March '67 "ELECTRONICS AUSTRALIA"

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It offers all the advantages of the simple thyristor controller, together with circuitry which makes the model perform just like a real train.

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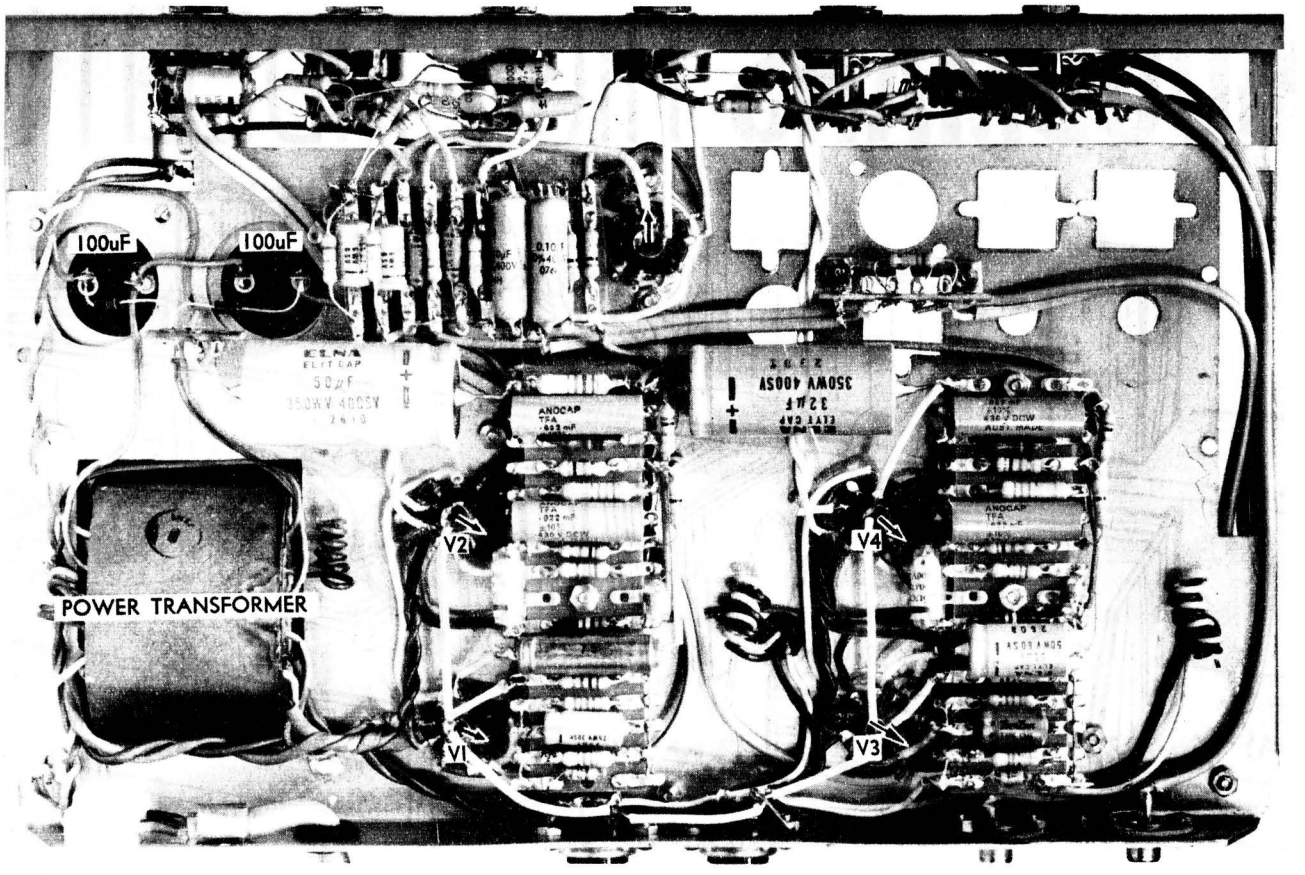


An underneath view of the amplifier, with most of the wiring components neatly arranged on tagboards. These are diagrammed on page 83. The vacant holes used for the tuner in the 106 tuner/amplifier are evident, but this area can very logically be used for a solid-state preamplifier board, if it is intended to use a high quality magnetic cartridge.

for the constructor but the circuit itself is virtually unchanged.

As will be apparent from the photograph of the chassis, two "push-in" type shielded sockets are provided on the rear lip for connection to a stereo cartridge. Where it is intended to use a magnetic cartridge, the connectors would be wired to a transistorised preamplifier board to boost and equalise the signal before it is passed on to the valve circuitry proper. Where a ceramic or crystal pick-up is to be used, the preamplifier is unnecessary, the available signal being suitable for direct application to the amplifier in the simple form as pictured. (We plan to describe a suitable preamplifier in our next issue.)

As already mentioned two sockets are mounted on a vertical plate behind one output transformer—a DIN socket for high level tape inputs and outputs and another socket (preferably dissimiliar) for possible connection to a Playmaster AM radio tuner.

The various input signals are directed, as desired, by the Selector and Mode switches to the grids of a 12AX7 high-mu twin-triode used as a preamp for both channels. Use of this high-gain valve secures an input sensitivity of 110mV RMS for full output, enabling even low output ceramic cartridges to drive the amplifier to full power.

In specifying a 12AX7 as a first choice, we are assuming that most constructors of an amplifier such as this will, in fact, select one of the better quality ceramics. If a crystal cartridge is used, its higher output could lead to some distortion, since the 12AX7 approaches overload with input signals greater than about 1.7 volt RMS.

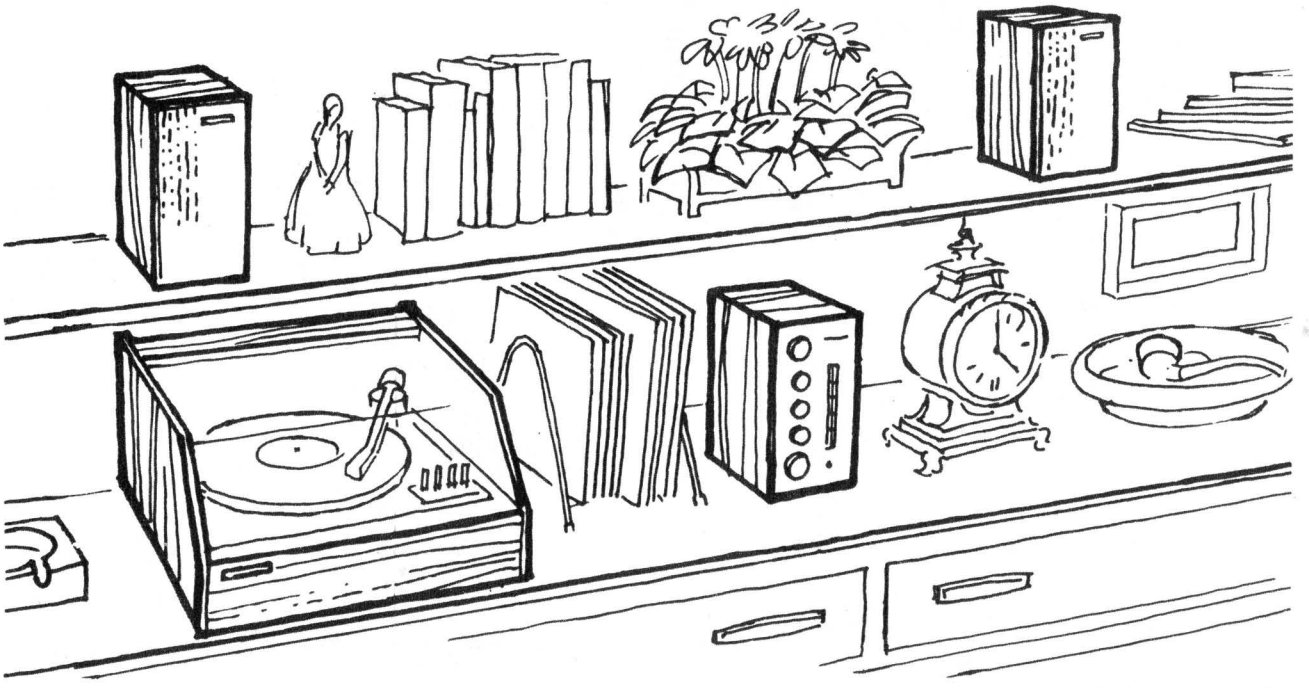
Those who already have a crystal cartridge on hand could reduce the gain by substituting a 12AU7 as a direct plug-in replacement. For best operating conditions, however, the cathode resistors should be increased to 2.2K and the 120pF capacitors in the input balance network reduced to 33pF. With the 12AU7, the sensitivity falls to 360mV for full output, a figure which is ample for crystal cartridges.

Alternatively, the signal output of any piezo cartridge—crystal or ceramic — can be reduced by connecting selected values of capacitor across the respective output leads. This has the added advantage of reducing the effective source reactance, relative to the load resistance and extends the bass response, whilst lowering the output over the rest of the range. A little experiment can establish the desirable conditons where the pickup can just comfortably overload the amplifier with the volume control a little less than full on.

The balance control consists of a single 2-meg linear potentiometer, with each "leg" connected to the triode grid in each channel and with the moving arm connected to earth.

Following the preamp. stage come the tone control networks and the volume control. Putting the controls in this relative position in the circuit makes it necessary to protect the preamplifier valve against overload, as already outlined, but it makes for a much "quieter" amplifier. Any hiss and hum from the preamplifier stage is attenuated by what-

GOODMANS HIGH FIDELITY



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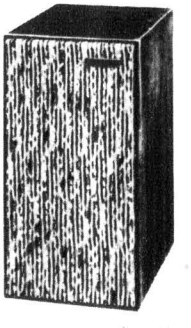
For the first time, GOODMANS offer **all** the units you need for "component" high fidelity. Now you can buy your record player, amplifier and speakers . . . **all** bearing the famous name of GOODMANS. As illustrated above, the components provide flexibility of placement on your bookshelves, desk or built-in furniture in a way that is convenient, unobtrusive and in perfect harmony with modern decor.

GOODMANS MAXAMP 30 AMPLIFIER

No bigger than a stout book, the **MAXAMP 30** is a fully transistorised stereophonic high-fidelity amplifier using silicon transistors throughout It will deliver continuously up to 15 watts of power on each channel and it looks as good as it is. In a polished wood cabinet with "Danish Silver" scratchgrain control panel. **Brief specifications are: Frequency Response:** 20 c.p.c.—20 Kc.p.s. plus/minus ½ d.b. **Distortion:** Less than 0.4 p.c. at 15 watts. **Inputs:** Mag. P.U. 3.5 m.v. at 47K ohms: Ceramic P.U., 50 m.v. at 100K ohms: Aux., 3 m.v. at 50K ohms: Tape, 150 m.v. at 100K ohms.

GOODMANS MAXIM LOUDSPEAKER

Only 10½" x 5½" x 7¼" deep. Fantastic! but true—the smallest **true** high-fidelity loudspeaker system made. It is, in fact, a complete system in miniature. Like the Maxamp amplifier, the MAXIM speaker is little bigger than a book, but with really outstanding performance. Up to 8 watts of power.



GOODMANS RECORD PLAYERS

Made by Garrard to do full justice to the Maxamp, these record players offer a choice of 10 different models for every application, private or professional. Housed in an attractive, dull-polished wood cabinet, it has a one-piece curved lid of tinted plexiglass. Priced from $73.65 (£36/16/6) to $178.43 (£89/4/4).

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ever amount the volume control is normally retarded, while there is less gain following the controls to amplify "scratching" sounds produced by faulty variable elements.

As can be seen from the tone control response curves, generous bass and treble boost and cut facilities are provided. This suits the amplifier to typical "bookshelf" loudspeaker systems, which usually require moderate bass boost, while still leaving enough bass boost for program correction or low level listening.

The tape outlets are supplied from the 0.1uF preamp. coupling capacitors via 56K resistors. Notice that the shielded cable to the DIN socket is earthed at a point adjacent to the 12AX7 socket. The signal to the tape outlets is independent of the setting of volume or tone controls, allowing tape recording to proceed with the amplifier completely silenced, or at any level desired for incidental listening or monitoring.

The rest of the circuit consists of two 6GW8s in each channel, in a well-proven configuration that has been used often in various projects over the years. The pentodes of the two 6GW8s are connected in a push-pull "ultra-linear" mode.

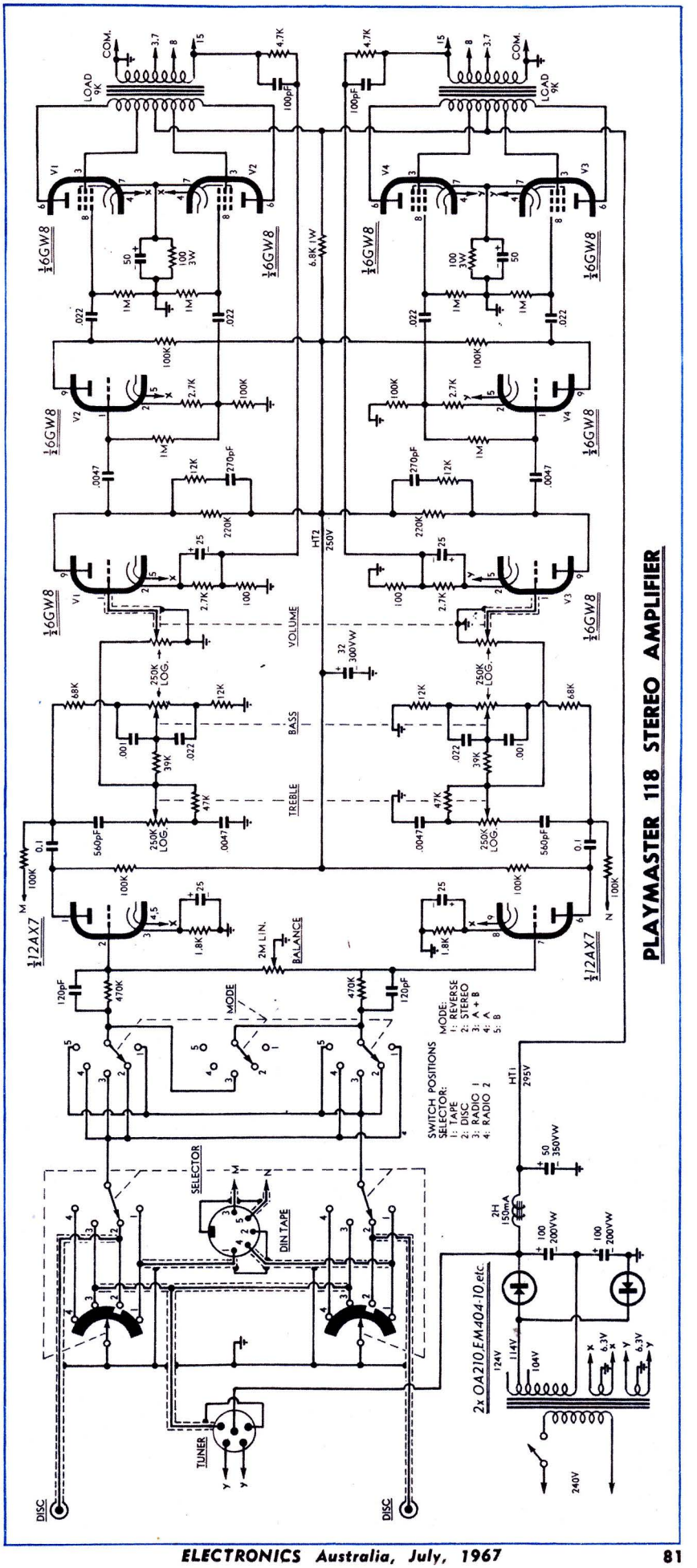
The triodes of the 6GW8s are used as voltage amplifier and phase splitter in each channel. A step circuit is connected in the plate circuit of the voltage amplifier to roll off the frequencies above 20KHz and thus minimise the risk of instability at supersonic frequencies.

Negative feedback is applied from the 15-ohm secondary of each output transformers to the cathode of the relevant voltage amplifier triode. The feedback is of the order of 14dB, which seems quite "puny" when compared with the amount used in some transistor amplifiers. However, the ultra-linear connection confers an additional benefit and the performance of the power amplifier as a whole is very good, as will be evident from the distortion figures quoted in the specification panel.

Notice the phase-correction capacitor connected across the feed-back resistor. This is used to offset the phase rotation in the output transformers as the frequency increases. It is normally selected using a square wave generator and a CRO, but the value shown should be very close to the mark for the output transformers which constructors are likely to use in this design.

The transformers are supplied with multi-tapped secondaries for loads of 3.7, 8.0 or 15 ohms. We suggest, however, that the transformers be wired with

The complete circuit diagram of the new 118 amplifier, as it would be for those planning to use a ceramic pickup. For a crystal pickup, delivering higher output, it would be wise to substitute a 12AU7 for the 12AX7 input stage, or reduce the output of the crystal cartridge, as explained in the text. For a magnetic cartridge, a preamplifier will need to be added, which will be presented next month. In practical service, the performance of this amplifier should be indistinguishable from the 115 Playmaster, described in the May issue.



the "Common" side of the secondary to chassis and with the feedback taken, as shown, from the 15-ohm tapping. The loudspeakers can be connected across whole or part of the winding, as required.

The transformers sold for this and the earlier 106 Playmaster are constructed with "grain-oriented" laminations. They are rated for 12 watts RMS at 40Hz and, as such, are outstanding value for money when compared to the "super-fidelity" types which extend the power response to 20Hz and below — frequencies which occur very seldom in recorded music, anyhow!

Moving now to the power supply, it will be recognised as a conventional "voltage-doubler" full-wave system, with an LC network for effective filtering of the HT supply. The regulation of the power supply is sufficient to enable both channels to give the same power before "clipping," whether they are driven singly or simultaneously.

And now to the construction of the amplifier: Here, the major differences between the Unit No. 4 and the present amplifier will become readily apparent.

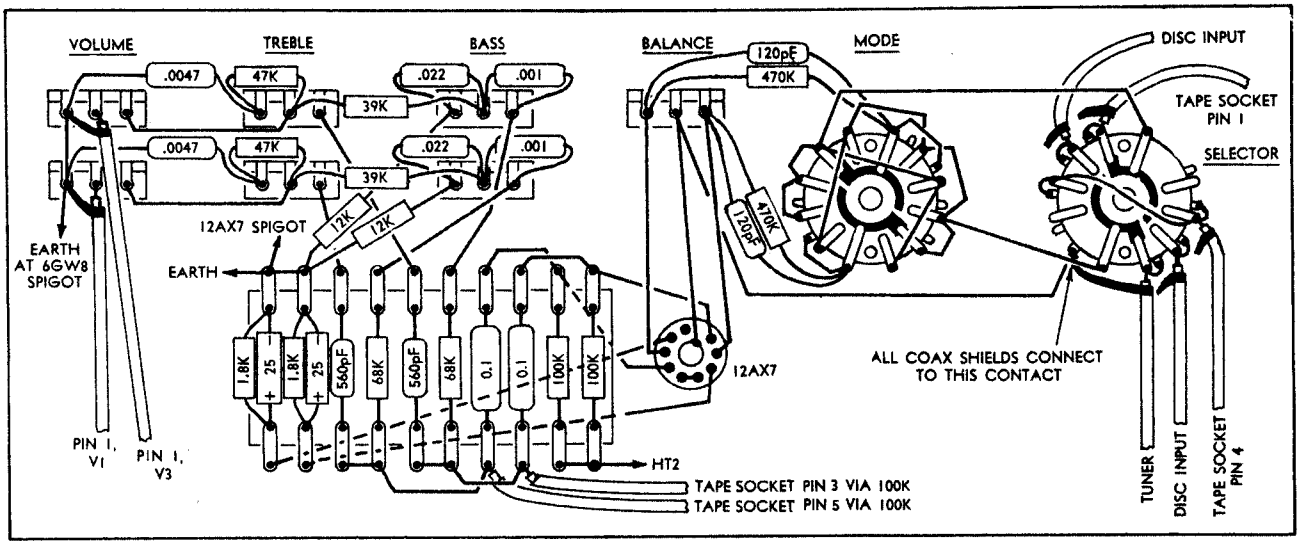
We used a Playmaster 106/107 tuner/amplifier chassis which means that the chassis manufacturers can "pension off" the Unit No. 4 chassis. It allows a more compact layout for the valve circuitry, leaving the space normally occupied by a tuner to be utilised for a transistor preamplifier for magnetic cartridges. We intend to describe this in a future article.

Combined with the chassis is the front panel from the Playmaster 115 transistor amplifier. This accommodates the new control layout, which is now standard on Playmaster stereo amplifiers. Some of our advertisers supply an anodised aluminium control panel to be used with the Playmaster 115, and this is attached to the front panel with the potentiometer nuts. However, it should not be mounted until the amplifier is complete and ready for installation, otherwise it may be marred by accidental scratches.

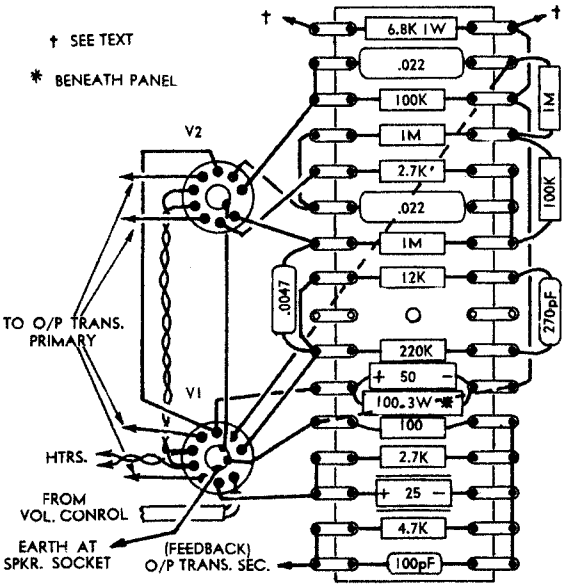
Four extra 1/8-inch clearance holes will need to be drilled in the front panel to enable panel and chassis to be screwed together. Use countersunk screws and see that the heads are flush with the surface of the sub-panel.

To begin the assembly, the bulky hardware, such as the power and output transformers, should be mounted first. The power transformer should be mounted on the chassis with spacing nuts, leaving in position the nuts already on the transformer. If it is mounted flush on the chassis, the chassis tends to become part of the transformer core, aggravating any possible eddy-current and hum problems.

Note that the output transformers must be mounted as shown so that their cores are perpendicular to the plane of the power transformer core — this to



These diagrams should assist materially in wiring up the amplifier. Depicted above is the wiring for the preamplifier board and the adjacent tone controls. At the right is the wiring for one power amplifier board, the two being identical except for a pair of lugs used to terminate the HT wiring. It is suggested that the boards be checked for mounting position, then pre-wired before installation.



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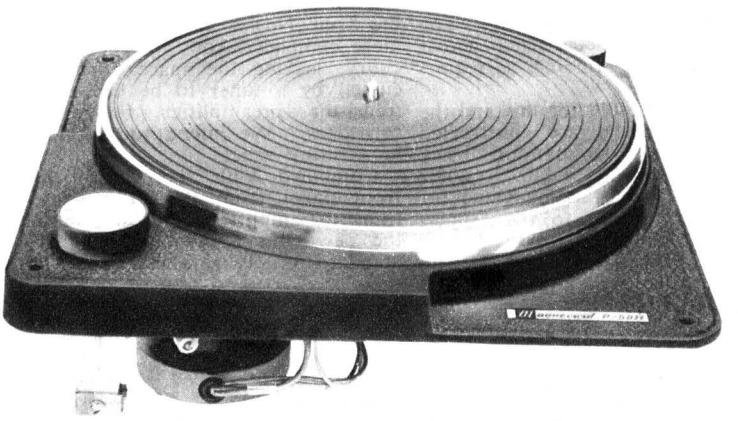

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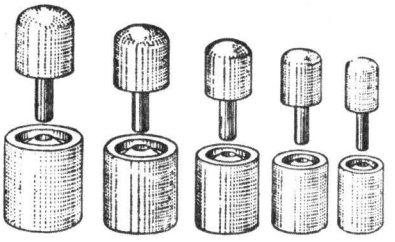

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13/16 inch ..	**3.20**	1-3/8 inch ..	**5.60**	2-1/8 inch ..	**9.00**	3¼ inch	**15.80**
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PARTS LIST

1 Chassis 12¼in x 7½in x 1¼in (Playmaster 106/107).
1 Panel 12¼in x 4½in (Playmaster 115).
1 Printed label (Playmaster 115).
1 Power transformer, voltage doubler type, 114 volts AC, 150mA DC, 2 x 6.3 volts CT-3A.
1 Filter choke, 150mA, 2Henries, DC resistance 125 ohms.
2 Output transformers, A&R Type OT 4005, Ferguson OP412 or equivalent.
5 9-pin valve sockets.
1 2-pole 4-position rotary switch with "earthing plate."
1 3-pole 5-position rotary switch.
1 5-pin DIN socket, 1 5-pin socket for tuner.

VALVES AND DIODES

4 6GW8.
1 12AX7 or 12AU7.
2 Power diodes, OA210, EM404-10, etc.

CAPACITORS

2 100uF/200VW Electrolytics, "voltage doubler" type.
1 50uF/350VW Electrolytic.
1 32uF/300VW Electrolytic.
2 50uF/50VW Electrolytic.
2 50uF/6VW Electrolytic.
2 25uF/10VW Electrolytic.
4 .022uF/400VW plastic.
2 .01uF/400VW plastic.
2 .022uF L.V. (low voltage) plastic.
2 .0047uF L.V. plastic.
2 .0047uF/125VW plastic.
2 100pF L.V. plastic.
2 560pF L.V. plastic.
2 120pF L.V. plastic.
2 270pF L.V. plastic.
2 1000pF L.V. plastic.

RESISTORS
(half watt unless specified)

6 1M, 8 100K, 2 470K, 2 68K, 2 47K, 2 39K, 4 12K.
4 2.7K, 2 4.7K, 2 1.8K, 2 100 ohm, 2 6.8K 1-watt. 2 100 ohm 3-watt.

POTENTIOMETERS

3 250K(log) dual ganged, 1-2M(lin).

SUNDRIES

Miniature tagboard, 2 16-lug, 1 10-lug.
2 2-pin speaker plugs and sockets, 2 phono input sockets and plugs.
6 knobs as in illustration, dual lamp holder with lamp and bezel, rubber grommets, miniature tagstrips, shielded cable, hook-up wire, etc.

minimise the 50Hz hum induced in the O/P transformers by leakage flux from the power transformer. The 1-inch long countersunk screws for mounting the tagboards should be fitted before mounting the O/P transformers. All holes in the chassis through which wires pass should be fitted with grommets to stop any chafing of the insulation.

Looking at the photograph of the amplifier layout above the chassis it will be noticed that we have moved one O/P transformer forward by a distance of ½in. This is to accommodate the auxiliary panel on which we mounted a DIN socket for tape outlets and inputs and also a socket for a tuner.

We made our panel from a piece of 16-gauge aluminium. The extra input sockets might conceivably have been mounted along the rear of the chassis but we preferred not to do so as they would have been hard against the output valve sockets.

Having mounted the transformers, the rest of the "hardware" can be installed. Due to the different design of the voltage doubler capacitor brackets, we had to drill extra holes to mount them. We re-sited the filter choke for the same reason. Extra holes have also to be drilled to fit another two screws to mount the tag-boards, which are longer than those in the original Playmaster 106.

Valve socket orientation will be readily apparent from the appropriate photograph. The potentiometers were set back by the thickness of one nut, allowing only enough thread to protrude to accommodate a nut and lock washer. This means that the control knobs can be mounted almost flush with the control panel.

Wiring can begin with the power supply and a word of advice to novice constructors is appropriate here. Do not use the same coloured hook-up wire throughout the amplifier. It makes wiring inspection and fault-finding so much more difficult. For example, red may be used for HT supplies, brown for heater supplies, black for earth returns, yellow for cathode networks.

The power supply is wired using the 114 volt tap on the transformer secondary. Those who intend using a Playmaster tuner are recommended to use the 104 volt tap otherwise the transformer will be overloaded, when the tuner is in use. Since the transformer is supplied with two 3-amp centre-tapped windings it is a good idea to load them equally. Each winding can supply a separate channel and preamp or tuner.

The tuner HT supply can be taken directly from the junction of the "voltage doubler" capacitor and filter choke via a 2Kohm decoupling resistor and a 32uF filter capacitor. This arrangement is least likely to upset the operating potentials in the amplifier. The network can be mounted in the amplifier chassis or tuner chassis; we chose to omit it to avoid crowding.

The power cord should be securely anchored using a metal clamp and insulated terminal block. The mains switch is incorporated with the volume control. This is an optional feature and some readers may prefer to keep all mains wiring away from the control section. Others like the convenience which the combined volume control/switch affords.

All wiring associated with the 6GW8 valves is contained in either of the two 16-lug tagboards. We have provided a wiring diagram of one of these tagboards which are similar except for the following: Notice the tags marked with an asterisk on the diagram; now refer to the under-chassis photograph and it will be seen that these tags are used to mount the HT filtering capacitors and the 6800-ohm dropping resistor.

In general, it is easier to partially wire the tagboards before mounting. For example, all the resistors and smaller capacitors can be inserted, soldered and

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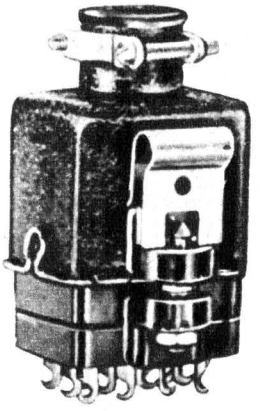
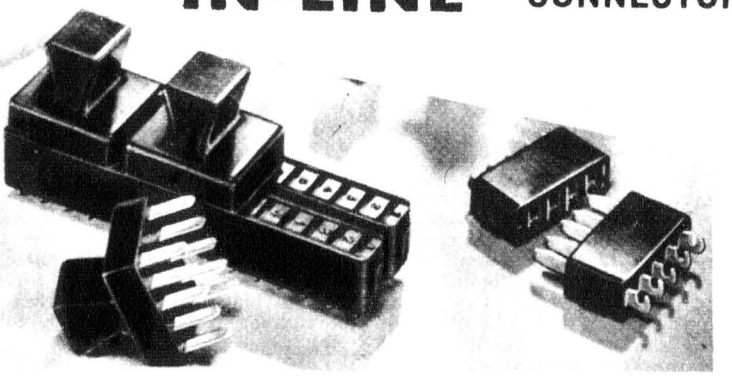
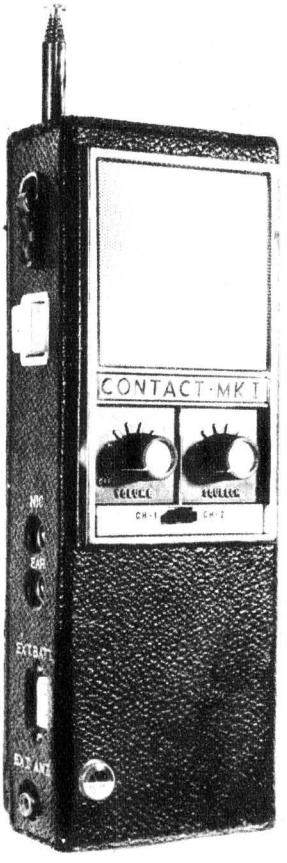


IN-LINE CONNECTORS





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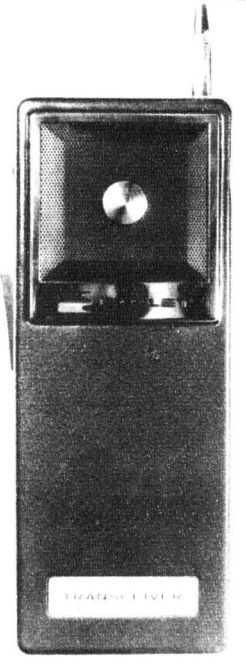

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pigtails trimmed. Note that the cathode resistor for the output pentodes is wired beneath the tagboard. Make sure that it is not jammed hard up against the metal chassis as the insulation might fail.

The 100Kohm resistors for the tape outlets were mounted on a separate tagstrip adjacent to the selector switches. These resistors can be omitted if the readers do not require recording facilities.

And here a word about the colour codes to be used when connecting the output transformers. Referring to the wiring diagram of the amplifier tagboard we have nominated the valve close to the rear of the chassis as V1 and the other valve as V2.

When using the A&R OT4005 transformer, the colour code is:

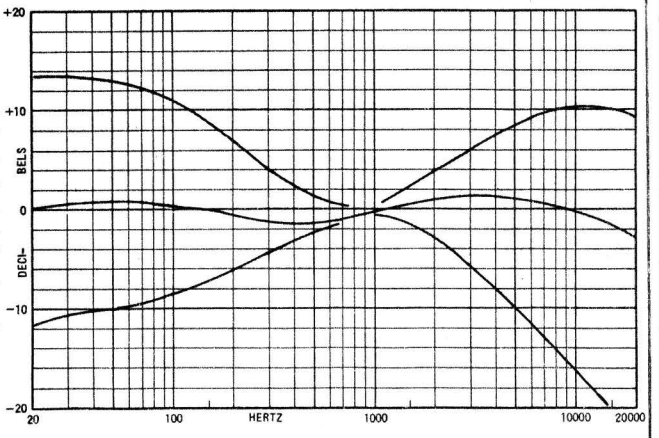
SCREEN 1.....Violet,
SCREEN 2.....Orange,
ANODE 1.....Blue,
ANODE 2.....Green.

The code for the alternative Ferguson OP412 is:

SCREEN 1.....Black,
SCREEN 2.....Yellow,
ANODE 1.....Green,
ANODE 2.....Blue.

With the common terminal of secondary winding earthed, the polarity of the feedback should be correct. However, if the amplifier breaks into oscillation when it is switched on, the feedback can be reversed by simply swapping the leads to the grids of the two pentodes (pin 8, 6GW8).

All earth returns associated with the 6GW8s are made to points adjacent to speaker sockets. The earth returns associated with the preamp. valve are made to an adjacent point on the chassis, while the shielded cable for the input signal leads should return via the "shorting ring" on the selector switch back to the earthing point for the preamp.



The response curves for the 118 are virtually the same as for the earlier 106 Playmaster. Following what is normal practice for high-fidelity systems, they cross over at 1KHz.

SPECIFICATIONS:

POWER: 8.5 watts rms per channel into 16 ohms, prior to clipping.

DISTORTION: Total harmonic distortion at 2KHz at 1, 3 and 8 watts is 0.26, 0.37 and 0.42 per cent respectively.

CROSS-TALK at 1 KHz: (one channel driven to full power) —38 dB.

SIGNAL to NOISE RATIO: 53dB below full output.

INPUT SENSITIVITY: 110mV for all inputs with input impedance of 1.5M.

FREQUENCY LIMITS (—3dB): 18Hz and 20KHz taken at an output level of 1 watt. Bass control 13dB boost and 10dB cut at 50Hz; Treble, 10dB boost and 20dB cut at 15KHz.

OUTPUT IMPEDANCE: (from 16—ohm secondary) approximately 2 ohms.

DAMPING FACTOR: Appr. 8.

The input shields should not be earthed at the input socket unless this proves later to give a noticeable reduction in residual hum and noise. The shielded cable to the grids of the voltage amplifier triodes is earthed to one of the 6GW8 spigots.

When assembly of the amplifier is complete all wiring should be double-checked against the circuit diagram. Then, if you have an ohmmeter on hand, check the HT line for short-circuits to earth. Touch the positive probe on the positive terminal of the first filter capacitor with the negative terminal connected to the chassis. The pointer should swing over towards zero and then move rapidly up the scale to a value of around 5Kohms, representing initial leakage through the filter capacitors.

The amplifier can now be switched on. Check the feedback as described previously. Then a check can be made on the "no-signal" voltages. If the voltages do not vary by more than about 10 per cent from those specified, the amplifier can be regarded as normal.

The following is a list of voltages obtained from the prototype using the 114 volt tap on the power transformer secondary, with no input signal applied:

HT1	295V
HT2	250V
12AX7 cathodes	1.3V
6GW8 pentode cathodes	7.8V
6GW8 triode (volt. amp.) cathodes	1.2V

Incidentally, the signal to noise ratio on this amplifier was measured with a 470pF capacitor shunting the inputs to simulate a ceramic cartridge. This gave a signal to noise ratio of —53dB relative to full output which improves to about —56dB with "short-circuit" inputs.

Now, you can connect your turntable, put on a record and settle back to enjoy a few hours with your newly constructed stereo amplifier. It can certainly produce some very nice sound and—plenty of it, if need be!

A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

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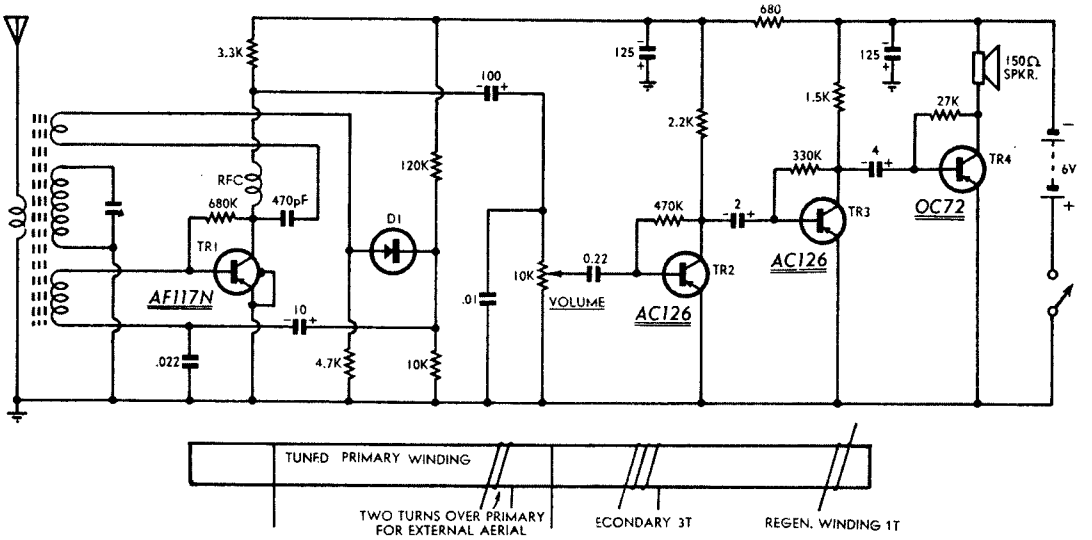

"I would like to submit the following for your 'Reader Built It' page. Other readers may gain as much satisfaction from it as I have.

"The result of much experimenting, the circuit consists of a reflexed stage involving the first transistor, coupled to a high-gain 3-transistor audio amplifier. It has enough gain to allow distant stations to be received at night, with just the ferrite rod. With a short aerial and an earth attached, stations can be received with ease.

"The regenerative turn greatly increases sensitivity and makes the selectivity quite sharp, at least for my location. In my case the regenerative loop had to be at least an inch away from the primary to prevent the set from going into active oscillation. I chose to use the pre-adjusted loop, but a conventional regeneration system and control could be used if preferred.

"Again, I used a 6-volt battery to supply the receiver, but a 9-volt supply could be used, provided the current drawn from the battery by the output stage in particular was not excessive.

"I used a ferrite rod 4 inches long and of 3/8-inch diameter. The exact number of turns for a given coverage will depend on the tuning capacitor used, but most experimenters will probably use a standard winding and a tuning capacitor of about 400pF. The secondary consists of 3 turns, wound at one end of the main winding. When an outside aerial is to be used, it can be coupled to the receiver by winding two or three turns around the main winding, as shown in the diagram. Since the ferrite rod, used without external aerial, is highly directional in its pickup, it must be rotated for maximum pickup for the wanted station. In fact, this effect can be used for a volume control function, if desired, or to discriminate against an unwanted interfering station.

"Transistor TR1 is an AF117N, stabilised by means of a feedback resistor and operates at 0.4mA. The RF signal is amplified by TR1, then demodulated and fed back to undergo audio amplification. An AF117N is used in preference to other types, such as the OC44, because of its much higher RF gain. In the writer's experience, if an OC44 is used, sensitivity is greatly reduced. The 100uF coupling capacitor was used because it was the only one on hand when the set was built, but a much lower value could be substituted. Any residual RF signal is earthed by means of the .01uF bypass capacitor.

"The audio signal goes to TR2 and then TR3, both AC126s and operating at 0.8 and 1.25mA respectively. Both are stabilised by feedback resistors.

"TR4 was a 2SB223 transistor, but any output transistor such as an OC72 could be used. It operates at 15mA and drives a loudspeaker with a voice coil resistance of 150 ohms. Output power is sufficient to produce sound enough for most purposes. Total battery drain is about 18mA.

"The decoupling network to prevent 'motorboat' oscillations consists of 2 x 125uF capacitors and a 680-ohm resistor. Lower values of capacitor may be found adequate.

"Finally, the regeneration coil has to be watched. A slight amount of movement is enough to cause large changes in volume. If the coil is bumped along the rod, the set is likely to break into active oscillation which will not only cause annoyance to the family, but may also cause interference with neighbouring receivers in weak signal areas."

(From G. Embery, Box 56, The Summit. Southern Line, Qld.)

(Continued on page 158)

KNOW YOUR GRAMOPHONE*

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By JOHN BORWICK, B.Sc.

PART TEN—MORE ABOUT AMPLIFIERS

The subject of amplifiers was discussed in the last chapter (April 1967) with special reference to the various functions of the pre-amplifier/control unit. Now, without trying to produce an exhaustive study of amplifier theory, a few words will be devoted to the ways in which amplifiers work.

We can begin by saying how they don't work—in the way a simple transformer works. A transformer (see figure 1) is useful for stepping voltages up and down. It consists of two coils of wire wound on the same "former" in such a way that, when an alternating electric current is passed through the primary (input) winding, the resultant rising and falling magnetic fields link with every turn of the secondary (output) winding. When this happens, the magnetic field induces a current into the secondary winding corresponding to a voltage which can be greater than the applied voltage in direct proportion to how many times the number of turns of wire in the secondary exceeds that in the primary. Thus, if the turns ratio is 1 : 2, the voltage is doubled; 1 : 3, the voltage is trebled and so on.

But "you don't get anything for nothing in this world," to paraphrase the Law of Conservation of Matter. Therefore the actual power in a transformer secondary cannot exceed that in the primary. (Indeed it will be slightly less, as the transfer is always less than 100% efficient.) And, since electrical power = voltage x current, a transformer which gives a 2 : 1 step up in voltage will halve the current which can be drawn.

By an extension of this argument, it can be shown that impedances can be stepped up or down via a transformer, the ratio of the impedances being the square of the turns ratio.

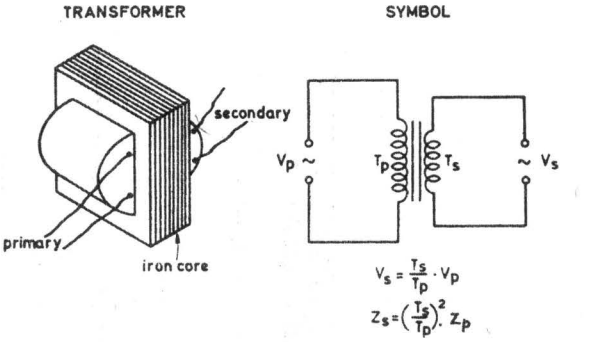

Figure 1: A transformer will give a step up or down in voltage according to the turns ratio. It may also be used for impedance matching

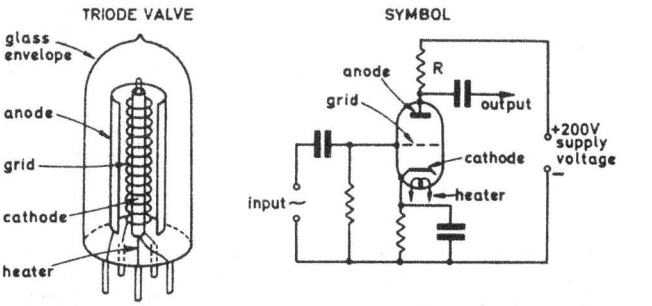

Figure 2: A triode valve will amplify AC signals by drawing power from a supply voltage.

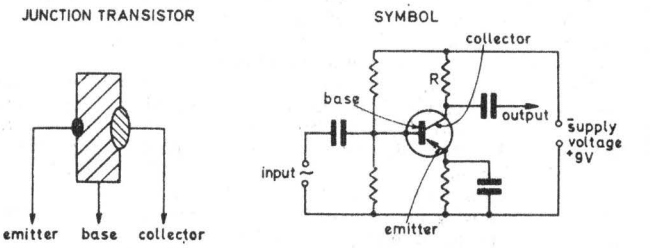

Figure 3: A transistor similarly depends on a power supply. The particular configuration shown here is called "common emitter".

How an amplifier amplifies: An amplifier genuinely boosts the power of the electrical signal and it does so by drawing on the steady power available from the AC mains supply (or batteries).

In the simple triode valve circuit in figure 2, once the heater has warmed up the cathode, the latter will emit a stream of electrons (negatively charged particles). These will drift through the evacuated valve interior towards the positive anode and so create a steady flow of current through the anode load resistor R.

Now, when the alternating input signal is applied to the grid (which is an open mesh construction placed between the cathode and the anode) the swings in grid voltage will cause an increase or decrease in the flow of anode current. Furthermore, because the grid is closer to the cathode, it is found that a comparatively small input signal voltage can cause large changes in anode current and, since this current flows through R, the swings in voltage drop through R represent an amplification of the original signal.

The transistor amplifier: The transistor amplifier works on an entirely different principle. It is essentially a sandwich of semiconductor materials — figure 3 shows one of the possible configurations, with its circuit symbol. The basic material of a transistor, germanium or silicon, has no "free" electrons and so it is a non-conductor. During manufacture, however, small amounts of impurity can be added to upset the electron balance and so produce a "semiconductor" material. Depending on the choice of impurity, the semiconductor can have too many electrons (N-type) or too few (P-type).

If a DC voltage is applied to a piece of N-type material, the surplus electrons will drift towards the positive terminal. Similarly, in a P-type material, the gaps or "holes" where electrons are missing can be taken to drift towards the negative terminal. When a P-N junction is formed, a degree of diffusion takes place so that an electrically neutralised region exists. Then, to produce a given current flow, it will require the application of a DC voltage or bias.

A transistor can be made to amplify by the correct choice of bias applied to the two junctions. In figure 3, for example, if the bias were arranged so as to give the base-collector circuit a much higher resistance than the emitter-base circuit then, although the currents in each circuit might be very similar, a considerable power gain is possible. (Power in a circuit is given by the square of the current times the resistance, so a roughly equal current in a larger resistance corresponds to the desired amplification.) The name transistor was actually developed from the two words "transfer resistor."

Figure 3 has been drawn in imitation of figure 2, to emphasise the points of similarity between a simple valve and transistor amplifying stage. It will be seen that the input is applied to the base of the PNP transistor (c.f. the grid of the valve) and the output is taken from the collector (c.f. the anode of the valve). The emitter in this "common emitter" configuration is equivalent to the cath-

* ***Reproduced by arrangement with "Gramophone" magazine.***

ode of the valve and is common to both the input and output circuits. The potential divider in the base circuit gives a stabilised negative bias to the base. The by-passed resistor in the emitter circuit appears to resemble the cathode bias resistor in the valve diagram but is actually to compensate for temperature variations.

Points of difference between the valve and transistors circuits are readily seen. For example, the transistor circuit is of opposite polarity (true only of PNP transistors). Also, the supply voltage is only a few volts, compared with around 200 volts for valves. This, combined with the greater efficiency of transistors, means that a much simpler power unit will suffice, less heat is generated and there is less risk of mains hum. The relatively lower impedances of transistor circuits have made it possible for a variety of designs to be produced in which direct coupling to the loudspeaker takes place. This means that an output transformer can be dispensed with — perhaps the most expensive component in a valve amplifier.

Precautions are necessary, when working with transistors, to avoid either excessive heat or short circuits. The former risk has led to the fitting of vaned heat sinks for mounting power transistors — so that a large area is available for heat radiation. The latter is combatted by the insertion of fuses in the HT line and the design of more elaborate loudspeaker terminals — to reduce the risk of accidental short circuits.

Looking at specifications: To round off this section on amplifiers, here are some comments on the technical properties listed in makers' specifications. By way of example, we shall use extracts from the specification of the Rogers Cadet Mark III stereo amplifier.

A TYPICAL SPECIFICATION

1. Inputs — Sensitivity — Impedance
   Pickup (magnetic) 3.8mV 68K
   Pickup (ceramic/crystal) 65mV 2M
   Radio 100mV 470K
   Tape 600mV —
2. Frequency response: 20-20,000Hz ± 2dB.
3. Harmonic distortion: 0.8% at 10W 0.25% at 5W (at 1,000Hz).
4. Intermodulation distortion: 3% at 10W (using 5Hz and 6,000Hz 4 : 1).
5. Signal-to-noise ratio: 60dB (radio); 54dB (Magnetic pickup).
6. Crosstalk: —42dB at 1,000Hz; —26-dB at 10,000Hz.
7. Power output: 10 + 10W (sine wave); 12.5 + 12.5W, (IHFM music power).
8. Power response: 9W, 40-10,000Hz.
9. Output impedance: 3-5 ohms and 12-16 ohms.

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1 Armstrong 222 integrated stereo amplifier. Power output to 10 watts push-pull. Frequency response: 30-20,000 c.p.s. plus or minus 1dB Power response 35-20,000 c.p.s. plus or minus 1dB. Harmonic distortion. Less than 0.5 p.c. at 1K/cs measured at 8 watts output R.M.S. Decca Deram diamond needle, 2 Goodmans 8in Twinexiette speakers or 2 Wharfedale 8in Super RS/DD speakers Garrard AT6 turntable. PRICE £109 **$218**

2 Pioneer SMB 161 11 watt per channel amplifier, 2 Wharfedale 8in RS/DD speakers, Dual 1010 turntable complete with cartridge. PRICE . .. £105 **$210**

3 Armstrong 227 10 watt per channel tuner-amplifier P.E. 34 4-speed Hi-Fi turntable with Decca Deram cartridge and diamond needle, 2 Goodman 10in. Twinexiette speakers PRICE £185 **$370**

4 Armstrong 220 stereo amplifier. Distortion Less than 0.1 p.c. at 1K/c measured at 12 watts. Power output: Ultra-linear 12 watts per channel. English best Stereo amplifier and Model 225 preamplifier. Dual 1019 turntable with Empire 888P.E. cart idge, 2 Tannoy 12in Dual concentric speakers. PRICE £381 **$762**

5 Empire Troubador turntable complete with Pick-up arm and 888P.E. cartridge. Armstrong 221 amplifier. 2 Empire bookshelf Imperial Grenadier speakers. PR. £625 **$1,250**

6 Armstrong 221 Amplifier P.E. 34 turntable with Empire 808 cartridge, 2 R and A twin-cone 10in speakers. TOTAL, £143. The same with Jordan Watts speakers $346. **$286**

7 JORDAN WATTS. A luxurious loudspeaker system suitable for a connoisseur's equipment, capable of a clean signal at good power down to 20 c.p.s. A frequency range is from 20 c.p.s. to 20,000 c.p.s. Power output 12 watts. For further details write to Recorded Music Salon, 23 Collins Street, Melbourne.

8 Pioneer SA 400 amplifier, Garrard AT 6 4-speed turntable with crystal cartridge. 2 Wharfedale 8-inch Bronze RS/DD speakers. TOTAL .. The same with Empire 803 cartridge $210. **$190**

9 Pioneer SMQ 300B amplifier, Labcraft 605L turntable. All Balance arm, B. and O. cartridge. 2 12-inch Goodmans Triaxiom speakers. TOTAL .. .. .. The same with Jordan Watts Modular speakers $368. **$420**

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COMMENTARY

1. Input sensitivity. The voltages given here are those required to give the rated power output (see 8).
2. Frequency response. The range from 20 to 20,000Hz covers all audible sounds. The qualifying ±2dB indicates the maximum amounts by which the amplifier response may vary within this range, 1dB (decibel) being about the smallest change in level detectable by the human ear. Specifications which quote a "frequency range" without this type of level qualification are meaningless.
3. Harmonic distortion. All amplifiers tend to introduce this type of distortion, which consists of the spurious production of harmonics (simple multiples) of each frequency present in the input signal. The amount of the distortion (given as the total level of harmonics as a percentage of the signal level at, say, 1,000Hz) increase at higher levels, as shown Amounts less than 1% may be regarded as acceptable.
4. Intermodulation distortion. For the same reason (non-linearities in the transfer characteristic) all amplifiers tend to introduce intermodulation distortion. The result is the spurious production of sum and difference frequencies corresponding to each pair of frequencies present in the input signal. The amount of the distortion is given as the total level of unwanted frequencies as a percentage of the level of two test frequencies fed in at the stated ratio (and in valve amplifiers is usually about four times the harmonic distortion). Amounts less than 3% may be regarded as acceptable.
5. Signal-to-noise ratio. This is quoted as the number of decibels by which the rated signal level exceeds the inherent noise level. This figure should include mains hum, unless otherwise stated, and may be a "weighted" figure —which means that the noise signal during measurement is passed through filters simulating the falling response of the ear at high and low frequences. Ratings greater than 50dB may be regarded as acceptable.
6. Crosstalk. Some break through of the left channel signal to the right channel and vice versa is inevitable. The negative dB rating expresses the ratio of this unwanted signal to that in the "wanted" channel. A figure of —40dB at mid-frequencies may be regarded as acceptable.
7. Power output. This expresses the electrical "size" of the amplifier — as the number of watts of electrical power it can deliver to the stated output impedance (see 9) without appreciable distortion. It is perhaps unfortunate that several alternative methods of specifying power have been introduced — two of which are used here. The "sine wave" method is generally to be preferred and simply states the RMS (root mean square) power attainable on steady tones. (Peak power would be twice this: peak power ratings are often quoted in America). The IHFM (Institute of High Fidelity Manufacturers—USA) definition of "Music Power" assumes that the DC supply voltage remains at the no-signal value. It tends to flatter amplifiers with badly regulated power supplies. In a good amplifier the IHFM rating should not exceed the RMS figure by more than about 30%
8. Power response. This important criterion specifies the bandwidth between the limits where the power output falls to half (—3 dB) for the rated distortion.
9. Output impedance. The figures given here are nominal and correspond to to the loudspeaker impedance required for optimum power transfer. Standard

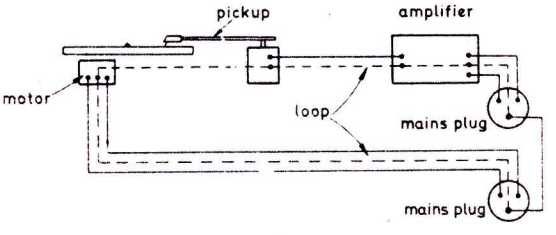


Figure 4: The earth loop, (broken line) gives rise to mains hum. It is avoided by omitting the earth connection on the motor mains plug or the motor/pickup earth lead

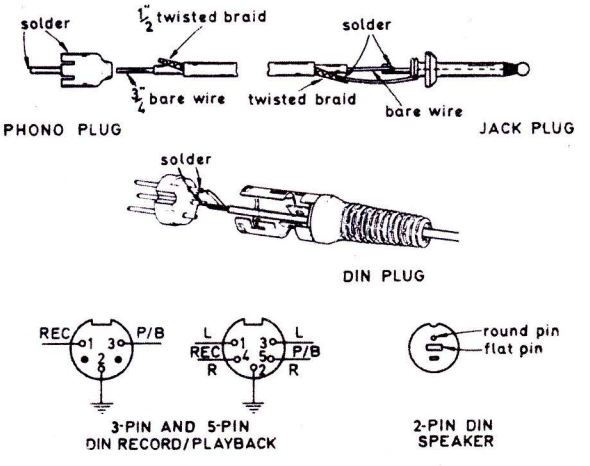


Figure 5: Showing the right way to connect up some popular types of signal plug. The DIN connectors are drawn as seen from the free end of the plug, or the rear of the socket.

impedances are 3.5, 7 and 15 ohms in the U.K., 4, 8 and 16 ohms in the U.S.A. In general, the impedance need not be critically matched, but the loss of efficiency resulting from the use of a 15-ohm loudspeaker (the commonest impedance in Britain) with a 3-ohm transistor amplifier (a common value on the Continent) is fairly serious and should be avoided. This question will be discussed in the next instalment.

Connecting up: My earlier mention of loudspeaker terminals leads me to the important subject of connecting pieces of equipment together. After all, the circuit details interest only a few gramophone users, whereas we are all liable to be faced with the need to connect a pickup to an amplifier, to a loudspeaker, to a tape recorder, etc. Strangely, the fitting of plugs and the choice and care of connecting cables are such fiddling operations that some people get into all sorts of trouble with them. To avoid this trouble:

1. Use the right types of connector.
2. Use great care in wiring.
3. Call in expert advice if you are really stuck.

Let us first talk about the mains connections. Ideally, one — and only one — of the pieces of equipment in your gramophone installation should be wired via a three-core cable and three-pin plug to a three-pin mains socket. The third, longer, pin is the earth connection. Here is the correct way to connect a three-pin plug. Strip back the outer covering from the flex end for a distance of 2in. If necessary, bind the frayed ends of braid with insulating tape. Position the flex so that the still-covered portion is as far inside the plug as it can go; now trim each wire to allow it to run to the correct terminal, plus ½in for winding round the terminal. Strip the covering from the wires and wind the bare wires clockwise to tighten. Connect the red wire and the black wire to the "mains" pins and the green wire to the "earth" pin. Twist and wind the wire on to the terminals in a clockwise direction so that when the nut is tightened the wire is tightened with it. Make sure there are no stray strands of wire, fit the plug top, and screw up.

The reason why I have suggested that only one unit should have an earth connection is to avoid what is called an "earth loop." Stray currents and magnetic fields, from transformers, etc., are an ever-present source of 50Hz mains hum. These fields will induce bothersome signals if a completed loop is allowed to exist via earth.

In figure 4, for example, the earth loop is shown as a dotted line. It can be broken either by leaving the earth wire off the turntable mains plug or by omitting the earth connection between the motor and the pickup. When a tuner or a tape recorder is coupled to an amplifier, the braiding of the co-axial signal leads should normally be the only earth route provided.

Signal connectors: It is a pity that effective standardisation has not been achieved for the types of plug and socket used in domestic gramophone equipment. However, the sketches in figure 5 will demonstrate the correct procedure for wiring the three most common types, namely phono, jack and DIN plugs.

The phono and jack plugs are simple enough since they consist of only one "live" lead and one "earthy" lead (usually the braiding on a co-axial cable). The DIN (Deutscher Industrie Normenausschuss) plugs appear in various formats. The standard style of three-pin, five-pin and two-pin DIN plug are shown in figure 5, but equipment manufacturers will sometimes alter the functions of the various pins, so it is as well to check their instruction leaflets before doing any wiring.

The drawings of the DIN connections are of the plug viewed from the free end, or the socket from the solder tags end. It will be seen that the central pin 2 is invariably earthed. Pin 1 is the Record connection in both three-pin and five-pin systems (the latter type being used for stereo) and Pin 3 is for playback. The two-pin system is widely used for loudspeaker connections and may be fitted in a reversible version so that adding an extension loudspeaker may or may not mute the built-in loudspeaker. All other DIN plugs possess a key-way and are irreversible.

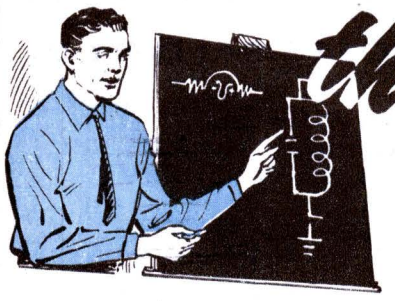
The next instalment will deal with loudspeakers, the types available, amplifier matching and positioning for stereo listening. ■

Wildlife Recordings

The sounds made by animals are a regular feature of B.B.C. radio and television programs about wildlife and even figure in programs. They are drawn from the B.B.C.'s collection of natural history recordings, one of the largest collections of animal sounds in the world, at the headquarters of its Natural History Unit at Bristol. The person responsible for building up this collection—and himself recording many examples in the field—is its present librarian, the well-known naturalist John Burton. In a B.B.C. broadcast recently he talked about his work to producer John Sparks.

"There are 412 discs in the library, representing 748 species of animals and 550 birds," he said. "It all began with Ludwig Koch, the famous naturalist and broadcaster. Koch retired in 1951 and was succeeded by Eric Simms, who made full use of the first portable tape recorder and the parabolic reflector and added many new recordings to the collection."

Burton said that in the last decade or so, with the development of good reliable tape recorders, the number of recordists of wildlife, amateur and professional, had snowballed. He bought quite a lot of their recordings to make as representative a collection of world wildlife as possible. "It's very expensive for the B.B.C. to send me to faraway places like Africa, Australia or South America to make recordings, but I have contacts like, for example, Anthony Walker in Rhodesia who recently sent me a tape of an Eastern Scrub Robin. Some of our recordists in Britain have sent me splendid recordings. Sometimes an amateur enthusiast sends me a recording of, say, a very rare bird which may not be technically perfect, but is of considerable historical, tropical and primitive interest, for instance, a recording of a Great Reed Warbler." Recordings, he said, must be free of extraneous noises and should be recorded at a speed of not less than 3¾ips. ■



the "Answer Man" Explains

ABOUT DELAYED SOUND IN MOVIES, SATELLITE RELAYS

A reader's question about loss of sound synchronisation in a television movie provides opportunity to have a closer look at the subject of sound sync. both in relation to films and to the very new subject of transmitting television via synchronous satellites.

During a recent TV film presentation I was surprised to observe a serious loss of sound synchronisation. The sound failed for a second or so and when it resumed it was lagging the action by about this amount. This situation prevailed for several minutes, and was quite disconcerting. Then the picture blacked out for about a second and synchronisation was restored. How could this happen if the sound and picture are on the same piece of film?

Fortunately our correspondent supplied exact details as to the channel, the name of the film, and screening date, so we took the opportunity to check with the station concerned. They were most co-operative, and provided the following explanation:

TV stations use 16mm versions of standard 35mm theatre release prints. These combine the sound and picture images on the same piece of film, as in the original 33mm print, or as in 16mm prints for conventional projection.

In any sound film system it is necessary to scan the sound and picture images at different points in the transport system. This is because presentation of the picture image requires intermittent movement of the film, a frame at a time, past the projection gate. For obvious reasons the sound can not be picked off at a point where the film is moving in this manner. To overcome this problem, the sound is picked off at a point later in the transport system — usually below the picture projector — and after the intermittent action has been removed by an isolating loop and sprocket. The sound head provides further smoothing of the film movement by means of rotary stabilisers, and additional loops, so that it achieves virtually constant speed by the time it is scanned by the optical sound system.

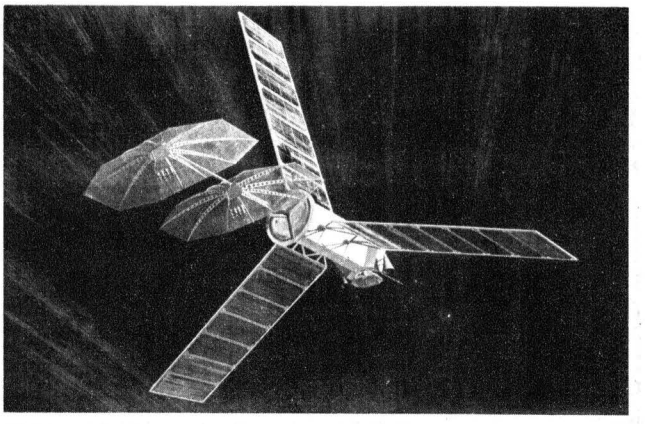
To offset the difference between the sound and picture scanning points, the sound track is printed ahead of the picture by exactly the length of film required between the projection aperture and sound head. In the case of 35mm films this is 19 frames. For 16mm it is 24 frames. Set-up marks for both the projection aperture and the sound head are provided on the film leader and, provided these are correctly located when the projector is threaded, sound and movement must synchronise and remain synchronised.

However, mention has already been made of the isolating loop between the picture and sound mechanisms and it is important that this be maintained. If it is altered for any reason, the 24 frame difference (for 16mm) will be lost and synchronism will suffer. Damaged film is the usual cause of loop trouble, and loss of the sound loop is the usual form which it takes. For example, a faulty sprocket hole may result in the associated frame not being pulled down from the projection aperture, while the film continues to move through the sound head. The effect of a lost loop on the film transport is so chaotic that, regardless of synchronising problems, it is usually essential to stop the machine and rethread it.

In the case we are considering, something like the opposite effect occurred. Apparently due to a faulty splice, the film jammed in the sound head for a period equal to 30 frames — about 1.25 seconds — during which time a 30-frame oversize loop was created between the picture and sound mechanisms. It was this stoppage which caused the brief loss of sound and the oversize loop which ruined the synchronisation.

One surprising aspect of all this is the fact that the system continued to operate in this condition. A 30 frame loop, travelling at 24 frames per second, can be an unwieldly thing, particularly if confined in the space of a normal sound head feed system. It will usually wrap itself around one of the sprockets, resulting in several feet of chewed up film. The operator concerned must have been extremely fortunate on this occasion.

The manner in which the trouble was eventually cleared is a little obscure, some of the details having been forgotten by the time we made our enquiries. However, it is known that some projectors are so constructed that it is possible to stop the movement of film through the picture mechanism by releasing the pressure on the gate, although this can be a risky manoeuvre. Nevertheless, the symptoms described — the momentary loss of picture — suggest that something like this must have occurred. Apparently the cine operator released pressure on the picture gate



Artist's concept of a satellite configuration which Lockheed Missiles and Space Co. is to study for the U.S. Communications Satellite Corp. The aim is to develop a satellite which will cope with domestic television and telephony distribution throughout the U.S., as well as intercontinental television and phone traffic and VHF or UHF traffic to ships and aircraft. Two 6 x 9ft umbrella-like dishes are for transmission, while a smaller dish at the far end is for reception. Also at the far end is a pair of supplementary horns, one for receiving, one for transmission. The "wings" carry solar cells which power the vehicle.

just long enough for the sound sprocket to take up the excess film, momentarily blacking out the picture while he did so.

And while we are on the subject of sound and vision synchronisation, it may be interesting to note some figures which were quoted recently on this subject. These were the results of some experiments conducted in the U.S.A. and Canada to determine how much error can occur without producing noticeable impairment in the presentation. Strangely enough, these investigations were not prompted by motion picture interests, but rather by those handling synchronous satellite transmission of TV signals. In some cases of satellite transmission it is more convenient to send the accompanying sound by an alternative route, such as an international telephone cable. In this case the sound will arrive at its destination ahead of the picture, due to the quite long round trip path via the satellite.

A synchronous satellite orbits some 23,000 miles above the earth. By the time we consider the angle between the incoming and outgoing signals the total path is unlikely to be less than 50,000 miles. At a speed of 186,000 miles per second, this amounts to .37 second (370mS) and, even if we subtract from this the time the sound takes to complete its journey, the difference will still be substantial and probably close to 300mS. This has been overcome in the past by recording the sound on a tape loop, with the replay head located the required number of milliseconds away from the record head. It was probably a desire to know just how much tolerance was permissible in such an overall system which prompted the test.

The results of these are particularly interesting, in that they show a different order of impairment depending on whether the sound leads or lags the vision. According to the report, ". . . a just noticeable impairment is produced, for 50 p.c. of observers, when the sound is delayed 140mS relative to the vision, or when the vision is delayed 70mS relative to the sound." From this, the seriousness of a 300mS vision delay will be immediately obvious.

Reverting to our motion picture situation, what do these figures mean in terms of the number of frames by which a loop can be in error before it is noticeable. At 24 frames per second, each frame represents about 41mS, so that a loop error of two frames in such a direction as to delay the vision—i.e., a loop that is two frames too small—would produce a more than noticeable error.

In some 16mm systems at least, this order of error is quite feasible without producing any obvious malfunction of the film transport. Only by taking proper note of the set-up marks on the leader or prescribed contours for the loop can correct operation be ensured.

In the reverse direction the tolerable error is greater but, equally, the scope for error is greater. For example it would require an oversize loop of four frames to exceed the permissible sound delay, but there would be no great difficulty in accommodating such a loop on some machines. So, once again, careful threading is the only answer.

And, finally, we understand that some large theatres deliberately modify the sound/vision relationship to allow for the time needed for the sound to reach the back of the hall. With sound travelling at about 1100ft/s (approx.) it will suffer a delay of 100mS for every 110ft it has to travel to the listener. At a distance of about 150ft the delay will be close to 140mS tolerance and, at greater distances, could be objectionable. It would seem logical, therefore, to advance the sound as much as possible to offset this, provided it did not exceed, for the front row patrons, the 70mS maximum permissible sound lead.

★ ★ ★

Imported dynamic microphones seem to be sold with about nine feet of shielded wire attached. Is there any objection to extending this lead by twenty or thirty feet, provided shielded wire is used?

We take it that you are referring to the type of microphone which is currently being sold for about twelve to fifteen dollars apiece, and used for non-professional public address and tape recording.

Most such units are of the so-called "high impedance" variety, meaning that they incorporate an output transformer and are meant to feed into a preamplifier grid or base circuit having an input impedance of upwards of 10,000 ohms. The output lead is usually a single, shielded conductor, with an outer plastic sleeve.

An additional length of shielded wire would increase the total capacitance shunted across the output transformer secondary and reduce treble response. The order of such treble loss would depend on the actual impedance of the microphone and input circuit, and on the amount of added capacitance. Naturally, the exact nature of the extension cable is most important in terms of shunt capacitance.

As a matter of interest, we connected to our R/C bridge a measured length of plastic-coated shielded hook-up, characterised by a stranded inner conductor and a relatively thin layer of black insulation between it and the earthed braiding. Such cable is commonly used for short runs within an amplifier. This wire turned out to have a capacitance of about 150pF per foot and a mere 6 or 7 feet, representing about 1,000pF, proved sufficient to drop the output of a typical high impedance dynamic microphone by something over 3dB at 5KHz. Therefore, unless quite severe treble loss could be tolerated, a long length of such cable would be out of the question.

On the other hand, so-called "microphone" cable, having much the same inner conductor, but surrounded by a slightly thicker layer of clear insulation, exhibited a capacitance of about 47pF per foot, indicating that about 20 feet of such cable could be used as an extension for a similar treble loss of 3dB at 5KHz. Some cable would appear to have lower capacitance again than this but it is more bulky and more expensive — perhaps, unacceptable so.

While a modest extension is therefore practicable, assuming the use of suitable cable, the best course, really, is to buy a low-impedance version of the microphone, with separate output transformer — assuming this to be available. The cable can then be extended over any likely distance, using either single-wire or double-wire shielded cable, according to what is already attached to the microphone.

The mic/grid transformer can then be fitted into the cable a short distance from the amplifier. It should only be installed in the amplifier chassis if it is a type thoroughly shielded against fields from the power transformer; it also means that everything fed to the input channel must then pass through this transformer, which may or may not be convenient.

Finally, here's a tip for those who are not too heavy-handed and who are prepared to attempt a modification **at their own risk:** The high-impedance dynamics can usually be disassembled to reveal the output transformer in the body of the case. It can be taken out and the speech coil wiring run straight to the existing output cable. Keeping careful note of the original connections, the output transformer can then be housed in a protective shield and wired into the cable adjacent to the amplifier. A stout protective and antimagnetic shield can be contrived from a water-pipe junction or a short length of ferrous pipe, with the ends plugged to retain the leads and the whole thing wrapped in tape.

Another tip: Don't measure continuity through microphone transformers with an ohmmeter. DC can adversely affect the core material. ■

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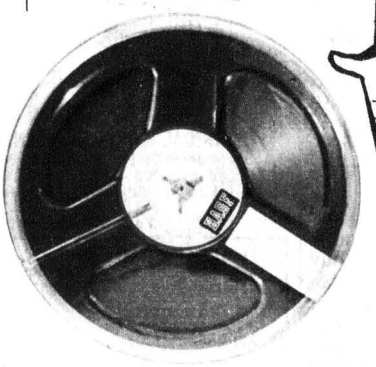

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AUDIO TOPICS

COMPATIBLE PICKUPS—NOT RECORDS!

The attitude of the major English companies to compatibility is summed up by the phrase; "Not compatible—Stereo only."

By Neville Williams

Last month in these pages, under the heading "How Compatible Is Compatible?" we explained the background to the so-called compatible stereo/mono discs now being sold in Australia and elsewhere. We pointed to the factors which rendered it self-contradictory to consider at one time a technique which would: (1) Preserve the full stereo potential of the 45/45 recording system and (2) Produce a record without significant vertical modulation and therefore prone to damage by at least a proportion of existing mono pickups. Really it boiled down to producing stereo records, relieved of extremes of vertical modulation, with the hope that the repercussions of playing them with mono pickups would be minimal. Mention was made that the major English companies were not in sympathy with the idea.

Hardly was the article in metal, when news came to hand of a press release by the EMI Company in England. We quote:

"One of the most important-ever developments in the record industry is revealed in the announcement today by EMI Records that from next July their classical long-playing records will be released in stereo only. A decision regarding stereo-only 'pop' LPs will be taken later in the year.

"The move does not make obsolete the mono record player. In fact, by using any modern lightweight record player pickup the stereo-only LP can be played on the mono record player. But EMI point out that for best results they recommend the use of a stereo pickup cartridge — now marketed at a reasonable price — to convert the mono record player. True stereophonic reproduction will, of course, be obtained only from a complete stereo reproducer."

Commenting on the proposed move, a spokesman for EMI went on to explain:

"We decided to take the initiative in introducing stereo-only classical records because we are quite sure it is an inevitable development largely made possible by the tremendous progress in record reproduction techniques and equipment.

"This stereo-only decision will benefit both the record dealer and the record buyer. The dealer will not have to order both mono and stereo LPs, and so duplicate his stock, and consequently he will be able to offer his customers a much wider range of recordings for selection."

Superficially, the announcement by EMI simply brings it into line with other major European companies who have already swung over to stereo only. ("Australian Financial Review" 26/5/67 quotes Telefunken, Polydor, Philips and D.G.G. as having produced only stereo or stereo/compatible versions for the last 12 months.) The vital difference is that EMI is not lending its support to the idea of branding its records as "compatible," in the sense that they can be played without damage by mono pickups. On the contrary, EMI would like to see record users re-equip with stereo cartridges, whether or not they proceed to a full stereo replay system.

Writing in "The Gramophone," John Borwick is apparently in full accord with the attitude of EMI. He says:

"In practice, these compatible records were a source of disappointment to a number of record-buyers who found that distortion or groove jumping took place with certain types of mono record players. Indeed, I have just heard that one budget-price record manufacturer in this country who recently brought out 'compatible' records has gone back to producing separate stereo and mono versions.

"So the 'compatible' record, which is essentially a stereo disc in which the maker attempts to avoid tracking problems on older mono pickups by subtly reducing the vertical element in the complex recorded waveform, has not been a success. It would seem that EMI, Decca and other large manufacturers were right in having nothing to do with this type of technical compromise. In record reviews in 'The Gramophone' we have simply treated these records as stereo and judged them accordingly."

In further discussion, John Borwick points out that discs recorded to the 45/45 stereo system are—and always have been—truly compatible in that they contain information in a form where it can be extracted and played in either stereo or mono. Likewise, a stereo cartridge is truly compatible in that it will track a 45/45 disc and will deliver either a stereo or mono signal according to the way in which its outputs are utilised. A conventional mono cartridge is NOT necessarily compatible, because it may lack the ability to track the vertical modulation component. This being so, non-vertical-compliant cart-

World Record Club

In their May, 1967, brochure, The World Record Club refer to the EMI announcement and point out that, already, 12½ per cent of their releases are in stereo (or stereo-compatible) only. The proportion is likely to rise steeply and, by mid-1968, virtually all new classical releases will be in stereo only. In answer to the question "What can you do about it?" the club advises:

"You can replace your mono equipment with stereo. But this could be very expensive — and possibly unnecessary. The next best thing to do is to replace, if possible, your mono playing head with a stereo cartridge and stylus. In most cases this will give you trouble-free reproduction, though of course without stereo effect. Lastly, if your playing-head is sufficiently light and the stylus assembly of sufficiently high compliance, you can play stereo and stereo-compatible on your existing mono equipment. You will get an acceptable mono sound — but you will permanently inhibit the stereo character of the playing grooves, and produce in effect what is a mono record—which will never again be truly effective as stereo. This in any case must be regarded as a last resort. Playing stereo records with a mono cartridge and stylus—even under optimum conditions—is asking for trouble, even though technically possible.

"The course mono members choose to follow is a personal decision and will obviously be influenced by a number of factors. But certain it is that mono is going out—and going out fast."

ridges should be sacrificed, not standards of ultimate performance. He goes on to stress that the industry should lend its weight to seeing that mono players are equipped — or re-equipped — with cartridges which will play full, stereo recordings. We quote:

"This can be achieved in two ways. First, a stereo cartridge could be fitted, with the two live leads and the two screens respectively joined together to form the mono outlet. This solution is perfectly acceptable, but it does mean a slight waste since the two sensing elements, etc., must have cost more to make than a mono transducer. (Also, no stereo equivalent to the existing mono cartridge may have been marketed.)

"The second approach is to fit a mono cartridge with the right characteristics, namely:

1. Fine stylus with tip radius of 0.0007in or less.
2. Low playing weight.
3. Reasonably high vertical compliance and low mechanical resistance.
4. Similar impedance and output voltage rating to the mono cartridge previously fitted.

"This latter approach has now received official backing and I have been told that, at a meeting on April 5, representatives of the equipment, component and record manufacturers reached agreement on a working procedure. In future, mono pickups will be marked on the box or on the cartridge to show whether they are suitable for playing stereo records. They will have styli in the range 0.0006/7in and the test will be their ability to track a special 7-inch test record produced by EMI Records. This has gliding tones at +22dB with reference to 1cM/s and has already been supplied to interested manufacturers.

"If this recommendation is complied with, we may expect all future British mono record players and radiograms to be fitted with compatible cartridges —something that Philips and Decca, for example, have been doing for a number of years. There will then be no longer any need for mono records to be marketed. The stereo record can be bought with equal confidence by owners of stereo and mono record players — though, of course, only the former will reproduce the spatial effect imparted by the twin channels. The EMI records will be normal stereo — they have always disliked the word 'compatible' — but will from July carry some clear statement to the effect that they may be played with a suitable mono pickup.

"It follows from the EMI Press Release, referred to earlier, that this discussion of compatibility is no longer an academic question involving just a few record importations. Owners of stereo equipment are not much concerned, but all owners of mono record players should take steps to ensure that their machine is able to track stereo records satisfactorily."

At this point, it is appropriate to append a statement by Cosmocord Ltd., manufacturers of the well known "Acos" brand pickup cartridges. The heading itself is significant, in view of the foregoing remarks:

STEREO-COMPATIBLE MONO PICK-UP CARTRIDGES

"Some of the major recording companies announced to the trade, in May, 1966, that as from some future date mono LP records will no longer be available. Only stereophonic pressings will thereafter be marketed and these notes will explain how this change in marketing policy will affect the design and choice of mono pick-up cartridges.

"A stereo recording has vertical as well as lateral modulations of the grooves. When playing such a record with a mono cartridge, the vertical modulations are of no interest and normal mono reproduction is provided by the lateral modulations. If record wear is not to be excessive, however, the stylus of the mono cartridge must be capable of moving vertically in sympathy with the vertical modulations and without undue restraint. This is the most important respect in which the stereo-compatible mono cartridge differs from the usual type of mono cartridge which is designed only for the playing of mono records.

"The restraint imposed upon the movement of the cartridge stylus is of three kinds. The **stiffness** of the cartridge mechanism is predominant up to about 500Hz. Stiffness is the reciprocal of compliance; the lower the compliance, the higher the stiffness. From about 500Hz to about 2,000Hz, the mechanical **resistance** of the cartridge mechanism is the major factor and at high frequencies still, the so-called **tip-mass** is the controlling quantity. Every one of the three forms of restraint must be suitably minimised in order to produce a satisfactory stereo-compatible cartridge. It is quite useless, for instance, to achieve adequate vertical compliance on a supposedly compatible cartridge whilst not also achieving sufficiently low vertical tip-mass. A stereo record, if played with such a cartridge, would suffer very serious wear.

"Doubts have been expressed as to whether high-output mono cartridges can be made stereo-compatible but these doubts are unfounded. The point is that high-output cartridges inevitably cause rather more record wear than their low-output counterparts but, provided that a high-output and supposedly compatible cartridge produces no more wear on a stereo record than its non-compatible version would on the equivalent mono record, then that cartridge is truly stereo-compatible. Such cartridges are not difficult to produce.

"There are two other main requirements of stereo-compatible cartridges and they are:

(a) **Low Vertical Sensitivity.** Although it is vital that the cartridge stylus easily follows the vertical modulation of the stereo records, it is equally important that these vertical stylus movements produce no significant output at the cartridge terminals. For undistorted mono reproduction from stereo records, the vertical sensitivity of the cartridge should be at least 15dB lower than the lateral sensitivity at low and middle frequencies. At the higher frequencies some increase in vertical output is permissible.

(b) **Tip Radius.** Many mono cartridges are fitted with tips of 0.0007in-0.001in radius but, for the satisfactory playing of stereo records, the tip radius should be no greater than 0.0007in. Stereo-compatible cartridges must, therefore, be fitted with tip radii in the range 0.0005in-0.0007in.

EDITOR'S NOTE: Amplion (A'sia) Pty. Ltd., of 29 Major's Bay Rd, Concord, N.S.W. are representatives in Australia of Cosmocord Ltd. They advise that, as from the beginning of this month, July 1, the GP 91-1 cartridge (medium output crystal) and the GP 91-3 (high output crystal) will be supplied with stereo compatible diamond styli. These cartridges may be used to play stereo records with no more wear than would be normal for any other cartridge involving the same order of output and tracking weight. Though not confirmed at the time of writing, it would seem logical to assume that similar remarks would apply to the equivalent ceramic cartridge GP 92-1 mentioned in our review, January, 1967, p. 97. ■

WHO WAS ANNIE LAURIE?

Listeners to the B.B.C. General Overseas Service "Scottish Magazine" program recently heard from Gordon Irving that "Annie Laurie" is the most popular love song in the world today. Annie really was flesh and blood, and Maxwelton House still stands, not far from Penpont village in Dumfriesshire; her boudoir is a delightful old world alcove on the first floor, and dew still lies on the gowan daisies along the "bonnie braes."

The composer of the song was William Douglas, a young army captain, born in 1672. He came from Kirkcudbrightshire in the south-west of Scotland, and fell in love with Anna Laurie of Maxwelton, and immortalised her in this song. But Douglas did not marry his Anna. Perhaps she jilted him, or her parents objected; he married Elizabeth Clark from Lanarkshire, and Anna married a rich young man, Colonel of the Horse, in the army of William III, Alex Fergusson, the owner of a goodly house not far from Maxwelton Braes. It is often thought, even by Scots, that Robert Burns wrote "Annie Laurie," but it was humble William Douglas, her unsuccessful suitor. Later, Lady Jane Scott of Buccleuch came across the verses, added the third verse, and the song caught the public fancy, and has remained popular ever since.

Classical reviews

By JULIAN RUSSELL

Lively and sensitive "Water Music"

HANDEL—Water Music (Complete). Hague Philharmonic Orchestra conducted by Pierre Boulez. Concert Hall Stereo SMS2379.

In terms of the publicity he receives Pierre Boulez is the world's leading avant-garde composer of the 1960s. Boulez, by the way, is a modest man who doesn't go out of his way to seek publicity. The nature of his work brings it to him, for composing is far from being his only activity in the musical world. He is a conductor of wide European repute, as at home in the playing of the romantic school (Wagnerian operas) as he is in the conducting of the works of his contemporaries. Moreover I have heard him conduct — among the music of other schools — that of his compatriot Debussy with a sensibility unmatched, and certainly not excelled, by any other conductor alive or of recent memory.

In addition to these activities he holds classes for advanced composition in several European cities during the course of the year.

Yet, knowing all this about Boulez, I must still confess astonishment at having found his name associated with Handel's "Water Music." This seemed to me to be right out of the run of his multiple interests. And I was still more astonished when, after having played only a few bars, I realised that I was in for a rare treat in a performance that was at once lively, sensitive, and perhaps, more importantly, essentially muscular. In fact, I did something that rarely happens when I listen to a record for the first time in order to review it. I stopped it, and repeated movements just for the sheer pleasure of hearing them again as soon as possible.

"Style" during the last generation has become a highly controversial feature in the performance of eighteenth century music. Double-dotting, the frequent use of unmarked appoggiaturas, trills, acciacciaturas and other ornaments are now added to the bare bones of the score in an attempt to reproduce the music "as it was originally played." And although these activities have the approval of, and are often initiated by, scholars such other important factors as the considerable rise in pitch since the eighteenth century which has put works into higher keys than those in which they were originally written, and the equally important change in timbre of many of the wind instruments, are ignored, and there are still arguments, many of them bitter — and some supercilious — about the authenticity of modern editions.

The sleeve notes state that the edition offered by Boulez is complete and I suppose that might be safely accepted. Three suites are included, in F Major, D Major and G Major. Unfortunately no reference is made to the origin of the edition, but that doesn't trouble me one tiny bit. For whatever it is it sounds fine—good enough to relieve me of the burden of any academic argument on its account. And the playing of the Hague Philharmonic under this versatile musician is in turn exhilarating, beguiling, and immensely impressive. The execution of the many trills and other decorations are faultlessly neat and crisp, and in some way or other Bou'ez has managed to make the woodwind seem to recreate eighteenth century timbre in the sounds they produce from their instruments. The horns chuckle merrily in some movements and supply support of grand solidity in others. As to the strings, they can assert themselves without pugnacity whenever necessary or reduce their tone to a murmur without losing quality in passages where they are asked to do no more than accompany. One of the most important requirements in music of this kind, in which every suite is made up of contrasting movements, is a judicious choice of tempos used in a way that sets one off against another. Boulez' tempos are exquisitely judged with this in mind and his rhythms full of bounce.

There is plenty of presence in the good, clean-cut engineering and I, for one, don't expect to hear a more enjoyable account of the suites than this in the foreseeable future.

★ ★ ★

HAYDN — Symphony No. 100 in G (Military).
Symphony No. 102 in B Flat.
New Philharmonia Orchestra conducted by Otto Klemperer. Columbia Stereo SAX05266.

My remarks about Boulez' sprightliness in his playing of the eighteenth-century music noticed above might be more easily grasped if, after having heard them, you put on these two Haydn Symphonies conducted by another musician of still more impressive credentials as a conductor, Otto Klemperer. Klemperer, in these two symphonies, uses one of the world's finest orchestras, the New Philharmonia, and they play for him with all the generosity of which they are capable — and that is plenty. But the overall effect is one of serious application to the task in hand without any trace of the manifest enjoyment in their work that their Dutch colleagues under Boulez introduce into the Handel.

While this treatment can, if you're temperamentally compatible to it, be condoned in the B Flat, which is probably the "biggest" of Haydn's symphonies, the "Military" was conceived and written in much lighter mood and need not have been delivered quite so ponderously. Make no mistake, the orchestral playing is never less than great. It's the attitude toward this essentially graceful music that makes me regret more than usual the passing of a conductor like Beecham who knew so well how to endow it with a lift that not only made one more conscious of its countless ingenuities but added to it a dimension absent in Klemperer's reading. But then, Beecham's Haydn was never approved by the Central European School, the members of which were always dismissing it as flippant. If you are of the same mind these Klemperer performances should suit you very well. In any case the sound is fine —though the composition of the orchestra sometimes hints at a rather more weighty body of strings than is customary in such music—and the players' execution unexceptionable.

★ ★ ★

BEETHOVEN—Concerto for Violin and Orchestra, Op. 61. Yehudi Menuhin (violin) and New Philharmonia Orchestra conducted by Otto Klemperer. HMV Stereo OASD2285.

The tendency of Klemperer to ponderousness, noted above was, I was surprised to find, communicated to Menuhin in his new recording of the Beethoven Violin Concerto. It is Menuhin's fourth recording of the work. He has played it twice with Furtwangler—once superbly —and again with Silvestri, in which he evinced some tenseness. This was probably because of interpretative difficulties that cropped up between the two, for Silvestri is a very mercurial musician, as may be remembered by those who heard him during his Australian tour some years ago when, at one concert, he chopped about ten minutes off the usual performing time of the "Eroica."

But in this performance Menuhin is —and I can think of no other word— ponderous, for the first time in my long experience of his work. Menuhin is now 50, but his recent recordings show no signs of any loss of the spontaneity and lyricism I had hoped to find in his new Beethoven. Klemperer's must be a very strong influence indeed to have resulted in a first movement so rigidly disciplined.

The Largo is, on the whole, better, but, give and take a few eloquent passages, I found little even here to thrill me. And perhaps the most disappointing movement of all three is the last, the Rondo, which I know Menuhin can make bounce along as daintily as one could wish, but which, this time, sounds very flat and wooden. Does Menuhin feel the work nowadays the way he plays it here, or was "the old man's" personality too much even for him at rehearsals? I'd love to find out.

★ ★ ★

BRUCKNER—Symphony No. 7 in E Major. Hague Philharmonic Orchestra conducted by Carl Schuricht. Concert Hall Stereo SMS2394.

Bruckner, if played with pious solemnity — and there are many temptations to introduce such an atmosphere into the music of this very godly man — can be one of the greatest bores I know. But this is something that Schuricht always carefully eschews in his many readings of Bruckner. His tempos, though often a shade faster than most other Brucknerian conductors, never suggest disrespect. Indeed he can even push along a movement like the well-known Adagio in this symphony without ever conveying the idea of irreverence.

His Scherzo spins along like a Viennese waltz, at a pace that even the most indulgent might for a while think excessive until a beautiful sensuous Trio section provides just the right contrast to balance everything into a nice formal pattern. And his Finale comes as close to jauntiness as it is possible to make it sound, again without any disrespectful suggestions. This record, by the way, was awarded the French Grand Prix du Disque, an unusual distinction for a Bruckner work from a French jury, for Bruckner is practically unknown in France.

The recording was made in 1963 when Schuricht had already turned 80. But there is no evidence of any slackened vitality in his control of the orchestra. Indeed two years later I heard him in Holland conducting the Hague Philharmonic Orchestra in the Scheveningen Kursaal. Schuricht was then badly crippled and had to be helped on to the platform supporting himself by two elbow-length crutches. With some effort he got himself propped up against the rostrum and went on to conduct as fine a performance of Brahms' D Major Symphony as any I can remember. The grand old fellow died only last year. The sound quality in this Concert Hall issue is excellent.

★ ★ ★

BRUCKNER—Te Deum. Teresa Stich-Randall (soprano); Sonja Draksler (contralto); Murray Dickie (tenor); Frederick Guthrie (bass). Vienna Youth Choir. Vienna State Symphony Orchestra conducted by Heinz Wallberg.

MAHLER — Kindertotenlieder. Hilde Rossel-Majdan and Vienna State Symphony Orchestra conducted by Heinze Wallberg. Concert Hall Stereo SMS2442.

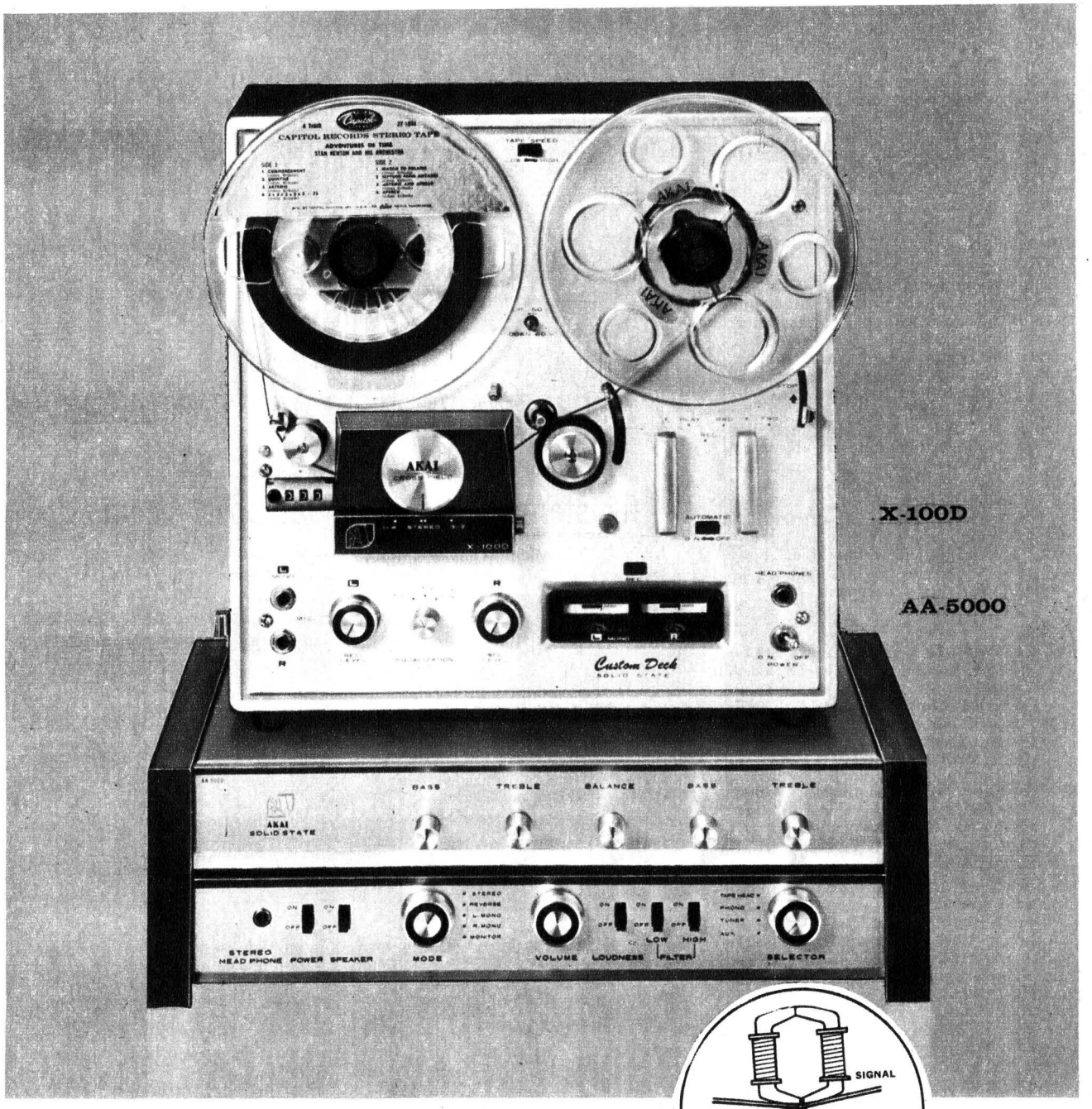
I am afraid that I cannot recommend this performance or recording of Bruckner with anything like the same enthusiasm. Both the playing and engineering are heavy-handed and the choir is impressive only in the quiet passages. And even here the basses sound too light to balance the other members of the choir. Teresa Stich-Randall sings enjoyably for the most part and Murray Dickie has a pleasing tenor voice. The other soloists are unimpressive.

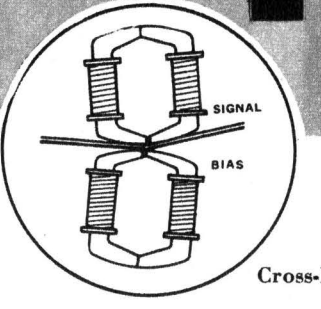
The Mahler is in every way better. In this Hilde Rossel-Majdan's voice is produced with admirable evenness throughout its range with a very attractive reediness in the low register. Her reading of the songs is simple and unaffected without an arch moment. The balance between the soloist and orchestra is consistently stable, but the engineering lacks bloom, a fact you can easily check by playing the last song. Unfortunately no copy of the songs' texts accompanies the record, which people unfamiliar with them might find inconvenient.

★ ★ ★

DVORAK—Symphony No. 6 in D Major, Op. 60. "Carnaval" Overture, Op. 92. London Symphony Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6253.

Decca have embarked on a project to record all the Dvorak symphonies with Kertesz and the London Symphony. This is the first to reach Australia—and very impressive it is. The work is strongly,





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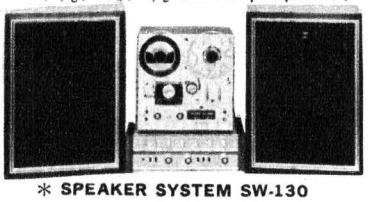

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but not overwhelmingly, influenced by Brahms and abounds in easily remembered but never commonplace melodies, and rhythms much sprightlier than any ever devised by Brahms himself. It also shows Dvorak already a master of the coda, the ending of a movement by a few cogent, exciting bars.

Although Kertesz is Hungarian by birth he knows just how to get that lilt into the playing that only the finest of conductors of Czech music—and most of those native born—seem able to do. Despite an occasional Brahmsian thickening of the inner voices of the orchestra the general effect is one of great brilliance. And Kertesz and the L.S.O. have now been together long enough to have played themselves into complete accord, at any rate in this type of music.

If you know Dvorak only by such works as the "New World" and the "Symphonic Variations for Orchestra," here is a piece that should win the affection of anyone looking for something new from an old, but seldom visited, friend. And for good measure there is the "Carnaval" Overture, as fiery as anyone could desire and, if a trifle on the showy side, not a whit the worse for that reason. Everyone in the orchestra seems to be enjoying themselves hugely, as I did. Strongly recommended.

★ ★ ★

DVORAK—Symphony No. 5 (No. 9, new style) in E Minor, Op. 95 (From the New World). "Carnaval" Overture, Op. 92. Philharmonia Orchestra conducted by Carlo Maria Giulini. Encore, Stereo S330EX9261.

DVORAK—Symphony No. 5 in E Minor, Op. 95 (From the New World). Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victrola VICS1155.

I can also recommend the Giulini performance of this, the most popular of all Dvorak's symyphonies, originally released as a Columbia recording but now available on the low-priced Encore label. Giulini does not perhaps glitter quite so brightly as Kertesz but still manages to fill the symphony with more than the average amount of excitement, and this without any freakish accenting or wild tempos. Perhaps the greatest difference in the two conductors' approach to this composer is Kertesz' spontaneity. Giulini gives the impression of having studied the work more carefully, perhaps because of his Latin origin, though he always avoids any hint of staleness, or even pedantry.

Moreover he manages to win some beautifully warm sounds from his orchestra without sentimentalisation of the music, even where this can be so easily added, as in the cor anglais theme in the famous Largo. There is a slight tendency, which I noticed more in the Scherzo than elsewhere, to record the woodwind just a trifle larger than life. Otherwise the sound is first rate. And on this disc, too, you have a rousing performance of the "Carnaval" Overture that might lack ever so little of Kertesz' sparkle, but is eminently exhilarating nevertheless.

After listening to this performance I find it difficult to recommend anything about the Reiner version. Reiner makes Dvorak sound much too formal in comparison to the two other conductors mentioned above. The whole of RCA's disc is devoted to the "New World" without a fill. The engineering is efficient but sometimes the sound is a little woolly.

★ ★ ★

THE ELISABETH SCHWARZKOPF SONG BOOK. Songs by Schubert, Schumann, Wolf, Debussy and Rachmaninoff. Seven Songs from Wolf-Ferrari's "Italian Song Book." Sung by Elizabeth Schwarzkopf (soprano) with Gerald Moore (piano). Columbia Stereo SAX-05268.

The Schubert and Schumann songs in this deliciously relaxed recital will probably all be known to most readers interested in lieder. In the Schubert group you will find "Der Einsame," 'Der Jungling an der Quelle," "Die Forelle," "Heidenroslein," "Claudine von Villa Bella," "Liebe Schwarmt auf Allen Wegen," and "Seligkeit." In the Schumann, "Myrthen," "Widmung," "Leis' Rudern hin," and "Wenn durch die Piazza." The Hugo Wolf, too, should be fairly familiar, "Wenn du zu den Blumen gehst," and "Die Zigeunerin."

But there won't be many who have heard of the Wolf-Ferrari bracket before. They are settings of Tuscan folk poems, some gay, some scornful — in fact you'll find them in every mood that you'll find lovers — in verse. All are entrancingly tuneful, a fact that will not surprise those who know the composer by his operas, "The Secret of Susannah," and "The Jewels of the Madonna." Schwarzkopf sings them with endearing simplicity and utterly without condescension. But there is one, in which a girl seeks a dead lover, that Schwarzkopf makes sound very dramatic indeed, a reminder of the great gifts of characterisation she uses to such good purpose in opera.

In the whole of the recital there was only one song that disappointed me — Debussy's "Mandoline," in which, though Schwarzkopf herself seems far from confrontable, there is the compensation of Gerald Moore's exquisite accompaniment. Moore is his usual incomparable self throughout. And though I haven't mentioned it so far, the recital ends with a performance by the two artists of "Danny Boy" that is so surprisingly beautiful that it may well bring you to reconsider the quality of this melody, debased though it has become by banal associations.

★ ★ ★

DELIUS—Concerto for Cello and Orchestra. Jacqueline du Pre (cello) and Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent.

Songs of Farewell (for double chorus and orchestra) Royal Choral Society and Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent.

A Song Before Sunrise. Royal Philharmonic Orchestra conducted by Sir Malcolm Sargent. Record Society S6223.

The soloist in this is the very gifted young English girl who recently made so impressive a recording of the Elgar Cello Concerto. And her performance of the Delius is just as eloquent, youthfully romantic but never fulsome. The work itself, for the most part, is serene and placid with its single reaching towards a climax subsiding before it achieves

a catharsis. It is all beautifully lulling music — if you are prepared to give yourself up to it without too much critical reserve. It is the Delius of "Brigg Fair" though that is, to my mind, a far superior work. The concerto is the sort of work you can listen to comfortably while thinking of something else. There is nothing showy in the solo part. Not even a cadenza. But it goes on a thought too long in the same vein. The engineering is adequate, but no more.

The "Songs of Farewell" set words by Walt Whitman to mellifluous sound, well performed by both singers and orchestra, but I must add a special word of praise for the deliciously played epilogue by the orchestra.

"A Song Before Sunrise" was dedicated to Delius' young friend and protege, Phillip Heseltine (Peter Warlock) and is an enchanting aubade, expressing perhaps as well as anything Delius ever wrote, his deep pantheistic love of earth. In form it is small, even miniature. But it is unremittingly shapely, tender, colourful and seraphic. It is played with manifest affection by Sargent and his orchestra. And now that Delius' name has started to reappear on the record catalogues after much too long an absence, perhaps we can look forward to re-recordings of such fine works as "Appalachia," "Paris," "A Mass of Life," "Brigg Fair" and others?

★ ★ ★

MUSIC OF SHAKESPEARE'S TIME. A collection of over 40 songs and instrumental pieces with Wilfred Brown (tenor), Eileen Poulter (soprano), Darien Angadi (boy soprano), Mary Thomas (soprano), Patricia Clark (soprano) and others. The Dolmetsch Consort. Soloists and Viols of the Schola Cantorum Basiliensis and others. Record Society Stereo S6217/8.

This is a most enjoyable anthology compiled and in some cases edited by the lutenist Diana Poulton who was no doubt prepared to receive the criticism aimed at all anthologists — the inclusion of some items and the omission of others. To my way of thinking she has done an excellent job in assembling two discs of music for the most part attractive, and never less than interesting. But in a program of this length there was bound to be some that appealed more than others. On the whole the two are unfailingly entertaining.

The eight soloists sing their various contributions with skill and good musical taste. Instruments used in other pieces include viols, lutes, virginals, recorders, tabors and others of more recent origin. That many of these are played by the Dolmetsch Consort will ensure prospective buyers of the quality of the performances.

Not all the pieces are to be found in Shakespeare's plays. Don't be surprised if a few are not even mentioned in them, and were included on the grounds of only the most distant relationship. You will even find some early Jacobean pieces in this elegant recital. You may, too, be mislead by the numbering of the various items in the sleeve notes (which, by the way, are satisfyingly informative both to scholars and tyros) but a glance at the record labels should very soon put things right for you to settle down to some very enjoyable listening. ■

DOCUMENTARY RECORDS

Reviewed by Glen Menzies

THE LEGEND THAT IS LAWSON: Read by John Clements with John Manifold and his Bandicoots. W. & G. L.P. 25/5006.

With such a scarcity of Australian material in the spoken word field, it is a pleasure this month to be able to devote the whole of this space to two L.P.'s featuring some of the best work by two of our most widely read poets. It was only the other day that a letter in the daily Press questioned whether anything was being done to commemorate the centenary of the birth of Henry Lawson. This record released just in time for Lawson's birthday on June 17th makes a very good start.

Henry Lawson was born in a tent on a goldfield at Grenfell in N.S.W., in 1867. His father was a Norwegian quartermaster, turned digger, carpenter, contractor and settler. His mother, who looked after the local store and post office, was a remarkable woman who later became a pioneer in the feminist movement and founder and editor of a magazine for women's rights. It was from her that Lawson's literary impulses came. Educated at the Eurunderee State School, his childhood was marred by the onset of deafness at the age of nine and an unhappy home life caused by the conflicting temperaments of his parents. He worked on the family selection and at casual bush jobs and later moved to Sydney with his mother where he became apprenticed to a coach builder.

Inevitably, Lawson became one of the growing army of job seekers, but in the meantime he was writing verse and trying to get it published. It was not until he reached the age of 20, when one of his verses was published in the "Bulletin," that his literary career began and he turned more and more to writing as a living. The decisive event in his life, however, was when the "Bulletin" sent him off on a six months tramp from Bourke to Hungerford on the Queensland border. Lawson was 25 and out of this experience came the inspiration for some of his best work.

The 14 ballads in this album include many from this period. They reflect Lawson's compassionate nature, and his feeling for humanity, which is often tinged with a note of loneliness and melancholy, as in "The Sliprails and the Spur," "Andy's Gone With The Cattle." The tenacity of man and beast is conveyed in the slogging test of endurance depicted in "The Teams." In contrast to these there is the wonderful onward momentum of one of the poet's happiest inspirations, "The Lights of Cobb & Co.," and the lyrical and romantic charm of "Reedy River."

The theme of social protest is uppermost in "Faces In The Street" a "poem of revolt" against the social ills of Australian city life which still makes a powerful impact with its sincere impassioned utterance, quote:

"They lie, the men who tell us,
for reasons of their own,
That want is here a stranger, and
that misery's unknown."

Also on a note of protest, but with a "Chaplinesque" touch and a measure of sly humour, is the well known, "When Your Pants Begin To Go." Another good choice is "Middleton's Rouseabout," a short, but clever character sketch of a "drongo" type who eventually takes over his boss' property.

This is a well chosen selection which will help to make new friends for the poet and may encourage some to look further into his short stories — an area in which Lawson is acknowledged as one of Australia's greatest writers. In what seems a rather odd arrangement, the first ballad on each side of this record is sung by solo voice with guitar, on side one a woman's voice of somewhat foggy quality, and on side two a rather better male voice. I feel that these could have been dispensed with entirely, in view of the very capable and professional reading by John Olements who makes no attempt to be aggressively Australian but takes a straightforward approach, with a little dash of characterisation when called for by the poems themselves.

★ ★ ★

BEST OF BANJO PATERSON: Read by John Clements with John Manifold and his Bandicoots. W. & G. L.P. 25/5003.

This album makes an ideal companion to the "Lawson" and gives the listener the opportunity for a direct comparison of the two poets' styles. But there is no question of Paterson and Lawson being diametrically opposed to each other. They are, indeed, viewing the same landscape through different eyes; the differences in outlook arising from matters of temperament, upbringing and experience of life. Banjo Paterson himself put it this way, "We were both looking for the same reef — but I had done my prospecting on horseback with my meals cooked for me, while Lawson had done his prospecting on foot and had had to cook for himself."

Although most of us live in an urban environment in this country, these ballads still have a unique way of evoking for us the atmosphere of the Australian countryside and man's place in its landscape. Paterson gathered material from a widely scattered community which included cattlemen, sheepstealers, shearers and drovers, the small township with its bush pub, the country race meeting and that indispensable animal, the horse.

Banjo Paterson's technical mastery of his chosen medium is quite apparent here with "Clancy of the Overflow" which begins the recital. This poem is now so famous that it can be all too easily taken for granted; that is, until one once again falls under the spell of:

And the bush has friends to meet him,
and their kindly voices greet him,
In the murmur of the breezes and the
river on its bars,
And he sees the vision splendid of the
sunlit plains extended,
And at night the wondrous glory of
the everlasting stars.

And equally, one can't fail to be caught by the gusto of "The Man From Snowy River" which gave the title to Paterson's first book published in 1895, a remarkable best seller with 10,000 copies sold in the first year. The story of another hair raising ride, and one which puts mechanical means of transport finally in their place, is "Mulga Bill's Bicycle."

Several of the ballads here reflect the writer's dry ironic humour and feeling for a well-told tale in the form of an anecdote, e.g., "The Bush Christening," "The Geebung Polo Club" and "The Man from Ironbark" with its wonderful description of the idlers in the barber's shop:

There were some gilded youths that
sat along the barber's wall.
Their eyes were dull, their heads were
flat, they had no brains at all.

I listened with amused fascination to the "Disqualified Jockey's Story;" here the poet reveals a perfect ear for the sound of a character and a special feeling for action in the description of the running of the rigged race. But in "The Traveling Post Office" I found quite touching the faith in country communication out on the central western plains where mail is just addressed "c/o Conroy's sheep."

The 12 poems in this recital give an exciting and satisfying glimpse of Banjo Paterson's talents as a balladist, and offer a variety of challenges to the reader with marked differences of pace, inner contrasts and possibilities for drama and character depiction. John Clements once again does very well in making the most of the material; these are sympathetic readings with the right touch of warmth and informality. Microphone placement is intimate but never overpoweringly so.

I am sorry that the texts of the Lawson and Paterson poems were not included. Even roneoed copies would be better than none at all. As on the other album, the first tracks on either side are sung; side 1, "A Bushman's Song" by a male singer and side 2, a very disappointing version of "Waltzing Matilda" by a female singer. At the moment there are far too many recordings of this song by indifferent singers, and as it still remains one of Banjo Paterson's most inspired creations I feel it deserves much better treatment.

These two albums are major additions to the local spoken word catalogue and have the added attraction of being released on the W. & G. Blue Label series which are bargain priced at $2.50 each. ■

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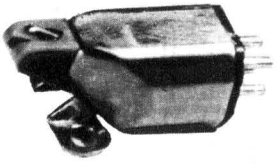

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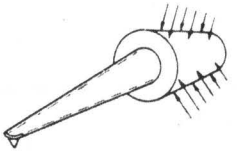

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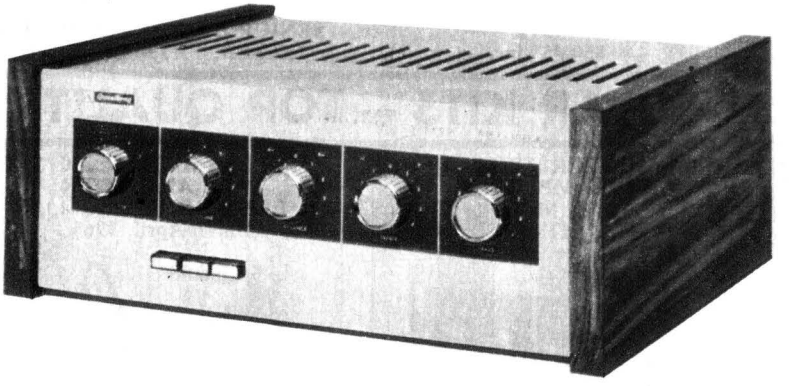

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★ "ELECTRONICS Australia" Staff Review Panel ★

Devotional

THE BILLY GRAHAM LONDON CRUSADE CHOIR. 2000 Voices. Crusade Choir conducted by Cliff Barrows. Stereo, RCA LSP-3698. Also available in mono LPM-3698.
Interest: "New" Crusade songs.
Performance: Massive, authentic.
Quality: Good.
Stereo: Impressive spread.

The London Crusade, conducted during June, 1966, in Earl's Court, turned out to be the most massive and most penetrating of any crusade ever conducted by the Billy Graham team. Total attendance at meetings exceeded 1,000,000, the largest single meeting at Wembley Stadium, supplemented by CCTV topping 100,000.

Massed choirs are no new feature of such crusades but I doubt that any choir ever sounded more massive, more genuinely spontaneous than these 2,000 voices, drawn from London and its environs. Not only this, but they have broken completely away from the range of hymns that seemed to have become crusade "standards" in earlier years.

The London choir sings: Heaven Came Down And Glory Filled My Soul—Praise, My Soul, The King of Heaven—Hallelujah, Praise Jehovah—Then Jesus Came—O Happy Day—Ye Gates, lift Up Your Heads On High—There's A New Song In My Heart—Surely Goodness And Mercy—I Have Decided To Follow Jesus — He's Got The Whole World In His Hands—'Tis Marvellous And Wonderful—Give To Our God Immortal Praise.

A record I can thoroughly recommend, particularly in view of Billy Graham's approaching visit to Sydney. (W.N.W.)

★ ★ ★

THE INCOMPARABLE MORMON CHOIR OF ENGLAND. Conductor, R. H. Barton, Jun. Organist, H. Robinson Cleaver. Stereo, Decca SKL-4819.
Interest: Excellent choir.
Performance: High standard.
Quality: Very good.
Stereo: Effective.

"Incomparable" is quite an adjective to live up to, particularly for a choir of 300 voices which had practised together for only one day prior to the making of this recording. Incomparable? Perhaps not, but you won't find many better examples of massed voices in the context of Gospel singing. Of special interest is the playing of H. Robinson Cleaver, an organist whose name I have not come across for quite some time. At the console of the large pipe organ in Colston Hall, Bristol, he produces some beautifully phrased accompaniments, with occasional bass notes that will bring a gleam to the eye of any hi-fi enthusiast.

Not all the hymns are known to me but they are all very acceptable in the context of Gospel music: Let The Mountains Shout For Joy—Sweet Is The Work—The Lord's Prayer—The Builder—Abide With Me—I Walked Today Where Jesus Walked—God Of Our Fathers—Holiness Becometh The House Of The Lord—Eternal Life—Stranger Of Galilee—Thanks Be To God—Love At Home—One World—Come, Come, Ye Saints.

Recorded before a large audience, each number is heard in complete silence but followed by applause and, in one interlude, by a baby's cry which someone must just have stifled until the last notes of the track had faded! Though the exception rather than the rule, the applause lends a "you are there" atmosphere and, incidentally, provides a most impressive demonstration of how stereo can spread sound right across one wall of the listening room.

Yes, an excellent record. (W.N.W.)

★ ★ ★

SWEET HOUR OF PRAYER: The Ray Charles Singers. Stereo, Calendar (Festival) SR66-935. Also available in mono R66-35.
Interest: Favourite Gospel hymns.
Performance: Modest but capable.
Quality: Good.
Stereo: Modest.

Re-released on the economy Calendar label, "Sweet Hour Of Prayer" contains 13 very well known Gospel melodies, sung in simple fashion by what sounds like a fairly small though competent group. Most of the numbers are sung with a minimum of accompaniment but, in one or two, the electronic organ backing reaches somewhat incongruous bass-heavy proportions.

The tracks: Sweet Hour Of Prayer—Softly And Tenderly—In The Garden—In The Sweet By And By—Beautiful Isle Of Somewhere—I Love To Tell The Story—Softly Now The Light Of Day—The Old Rugged Cross—There Is A Happy Land—We Gather Together To Ask The Lord's Blessing—Brighten The Corner—Let The Lower Lights Be Burning—Now The Day Is Over.

Not a record that I could get very enthusiastic about but one that, at the price, could bring pleasure to those interested in simple Gospel hymns, for their own sake. (W.N.W.)

★ ★ ★

WONDERFUL PEACE. Tennessee Ernie Ford with the Jack Halloran Singers. Mono, Capital T-2557.
Interest: Popular singer.
Performance: Vocally excellent.
Quality: Good.

As a singer of Gospel songs, one has come to expect a first-rate performance from Tennessee Ernie Ford and this album poses no exception. Whether singing with backing or a capella or reciting the sacred verse, his voice is full, smooth and rich. Generally, the Jack Halloran Singers also rate a good mention but I was not so happy with the instrumental accompaniment on side 1. In particular, the slap bass seemed altogether too prominent, too "tubby" and too random. In fact, as if the producer had sensed the problem, the same criticism cannot be levelled at side 2.

The hymns, all well known, are Crown Him With Many Crowns—Wonderful Peace—Beneath The Cross Of Jesus—Come, Thou Almighty King—I Love Thy Kingdom, Lord—The Beautiful Garden Of Prayer—Lead Kindly Light—Grace, Greater Than Our Sin—The Name of Jesus—Jesus, Lover Of My Soul—Saviour, Again To Thy Dear Name.

In short, a good disc as far as Tennessee Ernie is concerned but, to my mind, let down somewhat by the arrangements on side 1. (W.N.W.)

★ ★ ★

SPECTACULAR BRASS AND VOICES. Band and Songsters of the Salvation Army Congress Hall. Stereo, ATA (Festival) SATAL-932,195. Also available in mono ATAL-932,195.
Interest: Sydney band, chorus.
Performance: Robust.
Quality: Good.
Stereo: Normal.

This is an album which should find ready and automatic acceptance by all those with a Salvation Army background, or with an ear for the Salvationist style of music. With a history dating back to before the turn of the century, the Sydney Congress Hall Band comprises 40 players drawn from

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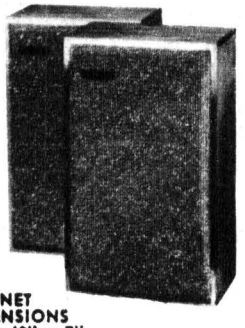

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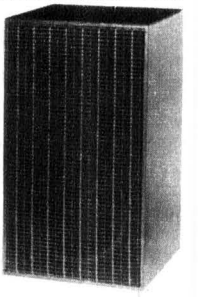

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● Valves used 6AN7 6N8, 12AU7 or 12AX7, 4 — 6GW8 and 2 — 0A210 rectifiers.

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some 26 Sydney suburbs. Under the baton of Max Percy, an experienced instrumentalist and conductor, they give an excellent account of themselves. So also do the songsters under Russell Belt. In fact, the whole presentation rated better with this reviewer than comparable programs I have heard from major overseas corps.

The track titles: Soldier Rouse Thee, Men of Harlech — Torchbearers — Slavonic Dance No. 8 (Dvorak) — Storm The Forts — Cleansing For Me — Soldiers Of Christ — The Scarlet Jersey — Let The People Say Amen —The Trumpeters — Jesus Died Alone.

As noted above, the quality is good, but the recorded level on the disc appears to be somewhat below average. Fortunately, the surface noise is low and turning up the volume control to compensate does not cause any complications. (W.N.W.)

★ ★ ★

WERE YOU THERE? Peter Marshall. Great Sermon series. Mono. Word (Gospel Film Ministry) W-3228-LP.

Interest: Well known preacher.
Delivery: Convincing.
Quality: Quite acceptable.

Rev. Peter Marshall, former chaplain to the United States Senate, was commended to many people who might not otherwise have known of him, by his wife's book "A Man Called Peter" and by the very successful picture made by 20th. Century-Fox, starring Richard Todd. Although it is quite some time now since I saw the picture, I couldn't help but note how my recollection of it fitted the photograph and the voice of the real person.

On this album are two sermons recorded by Peter Marshall during March, 1944, just before his death. "Were You There?" has an Easter theme. "Compromise In Egypt" takes a novel look at the conflict between Moses and the Pharaoh and is developed by Peter Marshall into a condemnation of compromise in Christian living and principles. Both sermons begin with a highly pictorial and seemingly well rehearsed description of the setting, the presentation gradually changing to a forthright proclamation of the message that Marshall is trying to communicate.

There is probably a limit to the number of recorded sermons one would want in a Gospel collection and a limit to the use which could be made of same but these two, delivered by such a famous and capable preacher must warrant special consideration. (W.N.W.)

Instrumental, Vocal & Humour

INSTRUMENTAL MUSIC OF THE COURTS OF QUEEN ELIZABETH AND KING JAMES. The New York Pro Musica Instrumental Ensembles. Universal Record Club, stereo U796. Available in mono.

Interest: Sixteenth century music.
Performance: Authentic.
Quality: Excellent.
Stereo: Rather restricted.

The idea of re-creating music of the post-renaissance era with authentic instruments of the period has been a labour of love of the New York Pro Musica for some years, and previous discs in their series of recordings have been reviewed in these columns on several occasions. This disc is devoted to English music of the period embraced by the second half of the sixteenth century, at which time English composers were very much in vogue, and were setting the fashions for the European musical world. The program presented here comprises: Five dances (Anthony Holborne) — In Nomine a 4 (John Ward) — Lord Willobies Welcome Home (William Byrd) — Il Lamento (Thomas Lupo) — Fantasia a 5 (Giovani Coperario alias John Cooper) — Two Masque Dances (Anonymous) — Fantasia a 3 (Thomas Lupo) — The Lord Salisbury His Pavane (Orlando Gibbons) — Five Dances (Anthony Holborne).

Space does not allow any examination of the music, but it is worth mentioning briefly that it is based on the old church modes, the present system of tonality not having been established at that period. This accounts for the rather ecclesiastical flavour noticeable throughout. The main instruments used are the cornett, which is a type of folded horn, not directly related to the cornet of today; the shawm, a double-reeded instrument, forerunner of the modern oboe; the sackbut, from which the trombone has directly descended; recorders or various types, from which the clarinet was eventually evolved (although no reed is used in the recorder); viols and rebecs, easily recognisable as the ancestors of the stringed instruments of the modern orchestra; and various other minor instruments no longer surviving in any modern form, e.g., the portable organ and symphony.

For those with any interest at all in music of the past, this record will have great appeal, since the Pro Musica are experts in the handling of the instruments they use, probably far better than the musicians of the period. Apart from this, I hesitate to make recommendations since the sounds made by the instruments may fall strangely on ears accustomed to the modern symphony orchestra. I am afraid it is a case of "if in doubt, find out" before buying. (H.A.T.)

★ ★ ★

ROMANTIC RUSSIA. The London Symphony Orchestra and Chorus, conducted by Georg Solti. Decca (E.M.I.) stereo SXLA6263. Available in mono.

Interest: Russian classics.
Performance: Excellent.
Quality: Demonstration standard.
Stereo: Wide, smooth spread.

In view of the limitations imposed by lack of musical training facilities in the Russia of the last century, the amount of excellent material produced by Russia's few famous composers of the period is remarkable. It is probable that much of the music which has survived would have sunk into relative obscurity if it had not been for the skill of Rimsky-Korsakoff as an orchestrator, since composers like Borodin, although able to compose beautiful melodies, were no great shakes at orchestrating their works. Of the five works on this disc, no less than four were orchestrated by Rimsky-Korsakoff. These are: Prelude

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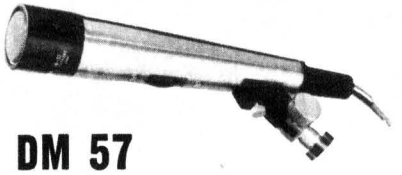

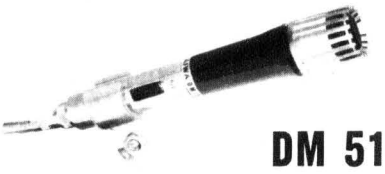

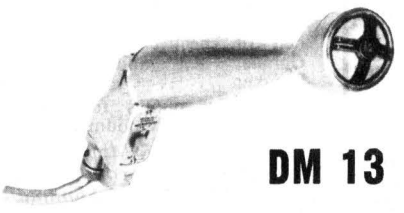

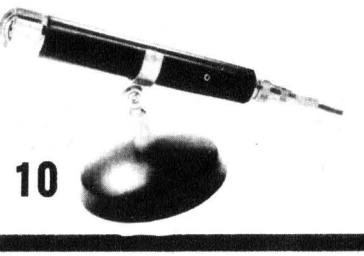

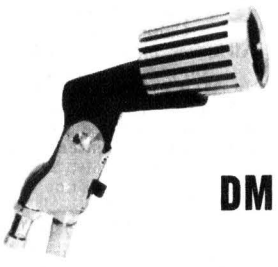

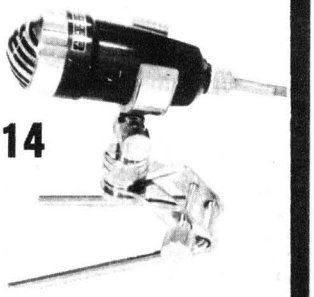

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from "Khovanshchina" (Moussorgsky)—Night on Bare Mountain (Moussorgsky) — Overture to "Prince Igor" (Borodin) — Polovtsian Dances (Borodin). The remaining work is Overture to "Russlan and Ludmilla" by Glinka.

Leaving aside the matter of program content for the moment, I found it impossible to fault this disc in any way. The playing of the London Symphony Orchestra under Georg Solti is absolutely splendid; the addition of the choral part to the "Polovtsian Dances" adds a measure of excitement which is often lacking in the purely orchestral version so often played; and technically, the disc is first class, with bright, clean sound and no trace of surface noise. I did feel a touch of disappointment at first with the lack of enterprise shown by the producer in selecting the program, since these particular works have been recorded so often in the past they are in danger of becoming hackneyed. In the final analysis, however, I was very glad to have the disc, since these splendid performances will certainly stand comparison with any alternative versions available. (H.A.T.)

★ ★ ★

AMERIACHI SPECTACULAR. The Tokyo Cuban Boys. King Records (Festival) stereo SFL-932,214. Available in mono.

Interest: Brass and Mariachi.
Performance: World class.
Quality: Excellent.
Stereo: Wide spread.

The odd title of this disc is presumably a misprint, for it is surely intended to be "Mariachi Spectacular." A glance at the tune titles will show why—every one has been featured by Herb Alpert: A Taste of Honey—Work Song—Hello Dolly—South of the Border—A Walk in the Black Forest—La Virgen de la Macarena—Spanish Flea—Lady of Spain —Magic Trumpet—Adios—What Now My Love—Taboo.

I must confess that the appearance of this disc on my desk evoked a mental groan. I had just about had my fill of Tijuana Brass imitators—and now this one, from Japan, of all places. But, despite these reservations, I thoroughly enjoyed the playing of the Tokyo Cuban Boys in their presentation of these familiar numbers. They produce a bright and lively sound, and their instrumental work and ensemble are in world class.

Most earlier reviews of King Records discs have commented on the technical excellence, and this disc is no exception. Those with a liking for Mariachi style music should make a point of asking for a demonstration when visiting their record supplier. I guarantee they will like what they hear. (H.A.T.)

★ ★ ★

FAMOUS OPERA AND CONCERT MARCHES. The Vienna State Symphony Orchestra conducted by Hans Swarowsky. Synchro stereo, Concert Hall SMS 2482.

Interest: As per title.
Performance: Excellent.
Quality: Clean.

At first glance,this might appeat to be along the lines of "favourite excerpts from the classics," but really it isn't. While the items will be well known to concert goers, the music itself is likely to be less familiar to potential "excerpt" buyers than the more usual sort of selection. Perhaps this is something of a commendation, particularly as the album features a definite theme — Famous Marches: March From Fidelio (Beethoven) — March Of The Priests From The Magic Flute (Mozart) — Turkish March From The Ruins Of Athens (Beethoven) — Three Marches For Orchestra K.408 (Mozart) — War March of the Priests from Athalie (Mendelssohn) — Entry March From The Gypsy Baron (Johann Strauss II) — Coronation March From The Prophet (Meyerbeer) — Hungarian March From The Damnation Of Faust (Berlioz) — Grand March From Tannhauser (Wagner) — Funeral Music From Gotterdammerung (Wagner).

Side 1 commences in rather modest fashion, with not too much spread, lots of bass from the middle and a suspicion that the compatible stereo-mono recording may have forced a not very inspiring compromise. But early reservations are dispelled as track follows track and the dynamics and spread of the Hungarian March leave nothing to be desired. The album concludes with the eerie but powerful Gotterdammerung.

Yes, well worth a hearing. (W.N.W.)

★ ★ ★

SPANISH STRINGS. Enoch Light and the Light Brigade. Stereo, Festival Project 3, SPJL-932171. Also available in mono PJL-32171.

Interest: Sound spectacular.
Performance: Precise.
Quality: Some reservations.
Stereo: Exceptional separation.

It was some years ago that Enoch Light first featured the use of 35mm magnetic film masters—and released some top-quality sound to emphasise his point. He seems now to be saying the same thing all over again, but with a new tag: "Project 3." Again—or still—the mastering would seem to be very good, with expert work at the panels, wide dynamic range, extreme separation where sought and virtually no background noise.

My impression, however, is that Project 3 engineers have been less than discrete in transferring their efforts to disc. The groove looks and sounds to be very heavily modulated and, while some of the sound is very hard and very clean, there are passages which had a definite "edge" with the good-average quality magnetic cartridge which I was using for the review.

Musically, it is a quite typical Enoch Light effort, with any amount of talent from arrangement to execution but all aimed at maximum sonic impact. Some will find it exhilarating, some rather noisy. The titles: April In Portugal—Without You—Come On, Don't Be Timido—What A Difference A Day Made—Perhaps, Perhaps, Perhaps—Maria My Own—How Insensitive—Someone To Light Up My Life—Lisbon Antigua—I Love, I Live, I Love—Blue Tango—La Mentira.

Best you hear it for yourself. (W.N.W.)

★ ★ ★

THE GREAT ARRIVAL. Sergio Mendes. Atlantic (Festival) stereo SAL-932,200. Available in mono.

Interest: Latin American jazz.
Performance: Cool, elegant.
Quality: Very good.
Stereo: Normal spread.

The main attraction of this disc is the tasteful and elegant playing of young Brazilian pianist Sergio Mendes. However, to this must be added the excellent arrangements by three well-known musical personalities in U.S.A.—Clare Fisher, Bob Florence and Dick Hazard. Finally, there are the enjoyable tunes included in this selection, many of them by Brazilian composers: The Great Arrival—Monday, Monday—Carnaval—Cancao do Amanhecer — Here's That Rainy Day—Boranda—Nana—Bonita—Morning—Don't Go Breaking My Heart —Tristeza de Amar—Girl Talk.

An anonymous group of competent musicians provides a solid framework around which the talented fingers of Senhor Mendes weave a pattern of cool Latin American jazz. This is Senhor Mendes' first disc, and I don't doubt that there will be many more to come. (H.A.T.)

★ ★ ★

TIJUANA TAXI AND OTHERS. The Living Marimbas. RCA Camden stereo CAS-961. Available in mono.

Interest: Latin American.
Performance: Stylish and original.
Quality: Very good.
Stereo: Well spread.

What a relief it is to get a record of Latin American music which does not use trumpets and Mariachi band. This one seems to be making a determined attempt to get away from the now

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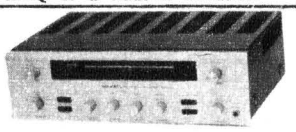

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A Mk. II "Compax" has just been introduced. The "Sound SAQ-202B" amplifier and speaker systems are the same; with this model the turntable supplied is the well known Labcraft 643, the tone arm has a lifting/lowering device, the cartridge is a high quality ceramic unit with a diamond stylus and the equipment is housed in an attractive base with a perspex dust-proof cover. This Mk. II "Compax" costs only **$145**

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rather tired formula mentioned above, and bases its melodies on the marimba. Those who are not familiar with this instrument may care to know that it is very similar in sound to the vibraphone, but is rather more mellow, with a deeper tone. The result is some sweet-sounding versions of the 10 numbers included in this selection (playing time just under 27 minutes).

Tune titles are: Tijuana Taxi—Perhaps, Perhaps, Perhaps—Spanish Eyes—Mil Besos—Spanish Harlem—Mexico Lindo—Made For Each Other—Maria Bonita — Tijuana Rose — Mu-Cha-Cha. These have been skilfully arranged and are tastefully conducted by Leo Addeo, whose own composition "Tijuana Rose" is included in this selection—the first time on disc, I believe. The instrumental work of the band is of the highest order, so all in all, at the low Camden price, this disc represents excellent value for money. (H.A.T.)

★ ★ ★

FAMOUS OPERA THEMES. Ray Martin and his Concert Orchestra. CBS stereo SBP 23353. Available in mono.

Interest: Opera evergreens.
Performance: Satisfactory.
Quality: Very good.
Stereo: Normal.

Every one of the tunes included in this selection has that quality of greatness which ensures a place in the affection of the music-lover. It is seldom that one can listen through a record of this kind and enjoy every track—there is usually a mixture of good and indifferent, for some reason. But whoever made the selection here knew his stuff, and I feel sure these tunes will have almost universal appeal. Titles are: All Are Caught in Love's Fond Snares from "Bartered Bride" (Smetana) — Oh! My Beloved, Daddy from "Gianni Schichi" (Puccini)—Habanera from "Carmen" (Bizet)—Upward the Flames from "Il Trovatore" (Verdi)—Lovely Flowers, I Pray from "Faust" (Gounod)—Lionel's Song from "Martha" (Flotow)—Drinking Song from "La Traviata" (Verdi)—Oh! Star of Eve from "Tannhauser" (Wagner)—Barcarolle from "Tales of Hoffmann" (Offenbach)—Intermezzo from "Cavalleria Rusticana" (Mascagni)—When the Stars were Brightly Shining from "Tosca" (Puccini)—Softly Awakes My Heart from "Samson and Delilah" (Saint-Saens).

The orchestra plays these in a very satisfactory manner. But I did feel that the arrangements showed a lack of finesse—for example, the marking of each bar by a cymbal in some numbers is unnecessary and distracting. Barring this small quibble, I can recommend this record to those who like the lighter and more tuneful numbers from opera. (H.A.T.)

★ ★ ★

REEDS AND PERCUSSION. The Command All Stars. Calendar (Festival) stereo SR66-9,168.

Interest: Enoch Light reissue.
Performance: Faultless.
Quality: Excellent.
Stereo: Good, but gimmicky.

The famous series of Command discs of a few years ago, master-minded by Enoch Light, were a highlight in popular music recording, combining as they did first-class musicianship, excellent arrangements and faultless recording. Those who have not yet obtained these for their record collection now have an opportunity to buy them at a bargain price, since Festival have now begun to reissue them on their Calendar label. This disc is typical of the clever orchestral combinations used in the series—it uses clarinets, saxes, bassoons and percussion. At least, that is what I make of the combination after listening—there is no sleeve note to help. Whatever it is, it is first-class playing, and thoroughly enjoyable.

There are 12 tracks, giving full value for money, instead of the 10 which are now becoming common, particularly in low-priced discs. Tune titles are: She's Funny That Way—Serenata—I Guess I'll Have to Change My Plan—Pavanne—As Time Goes By—I Want to be Happy—Bewitched — Badinage — S'posin' — Saxophobia—Thou Swell—Stompin' at the Savoy. The sound quality is well up to par, and it is only the gimmicky stereo which dates the recording—nowadays it is not regarded as clever to switch over from one channel to the other at the beginning of every track. (H.A.T.)

★ ★ ★

THE DISTINCTIVE PIANO STYLE OF FLOYD CRAMER. Floyd Cramer with orchestra. RCA Camden stereo CAS-2104.

Interest: Jazz pianist.
Performance: Routine.
Quality: Very good.
Stereo: Good spread.

There is nothing much to get excited about in this run-of-the-mill recording of popular numbers. Floyd Cramer and the supporting band play competently enough, but without much spirit—in fact, without any of those special qualities of artistry or style which lifts a recording above average level. The appeal for potential buyers will therefore be more in the titles than the performers, and if you want these particular tunes, this disc has the advantage of being available at the Camden price—just under $3.

Track titles: Tuxedo Junction—Cryin'—The Three Bells—All Night Long—Naomi—Don't Get Around Much Anymore—Tomorrow's Gone—Goin' Home—Kisses and Tears—Hong Kong. Technically, the disc is of a good standard. (H.A.T.)

★ ★ ★

RHYTHMS OF SPAIN. Sabicas with various artistes. Calendar (Festival) stereo SR66-9,151. Available in mono.

Interest: Flamenco.
Performance: First class.
Quality: Very good.
Stereo: Effective spread.

This recording of Sabicas playing what may be called modern as well as traditional flamenco is particularly good value, since it is an excellent recording, yet available on the low-price Calendar label. In addition to the great Sabicas himself, acknowledged as one of the leading exponents of flamenco, other flamenco artistes of high calibre participate in this program. Most of the emphasis is on the guitar playing and singing, but there is a very good demonstration of taconeo (heel tapping) in a soleares, by Dolores Vargas. In guitar duets, Juan de la Mata provides excellent support on the second guitar. There is no male cantor, but Antonia Andalucia sings in a pleasant soprano in the tracks which I have suggested could be called "modern flamenco," since it represents a departure from the traditional style.

The program consists of: Viva Mexico (Bulerias)—Fantasia Militar (Sitio de Saragosa)—Rumores de Granada (Granadinas)—Gardenia (Bulerias)—Aires de la Alhambra (Zambra)—Delalosno and Huelva (Fandangos) — Taconeo for Soleares—Son Como las Flores—Azahar Trianero (Sevillanas) — Aromas de Cadiz (Alegrias). This varied program makes very entertaining listening. (H.A.T.)

★ ★ ★

TYPICALLY IRISH. Brendan O'Dowda. Columbia (E.M.I.) stereo, SCXO 6078. Available in mono.

Interest: Irish ballads.
Performance: "Typically Irish."
Quality: Very good.
Stereo: Normal spread.

Brendan O'Dowda has been laying claim to the mantle of the late John McCormack with his singing. Now he seems to be making a bid to step into the shoes of Percy French for, of the 16 songs presented here, 11 are of his own composition. These 11 tracks are entitled: "Bedad," Say I—Old Bones—The Pig — Dan — Paddy's Britches — Molly Brannigan—Coortin' in the Kitchen—The Devil and the Woman—The Mac's and the O's—Flannagan's Ball—Typically Irish. These all sound to be well in line with the humorous Irish ballad, in which the Irish poke fun at themselves (for their own amusement, let me add, not for the enjoyment of "furriners"). It remains to be seen whether they will take their place in the repertoire.

The five remaining tracks are: Mick McGilligan's Ball—Father O'Flynn—When I Marry Molly Malone—The Charladies' Ball—The Bonny Wee Mare. All except the third item in this list should be known to those with a liking

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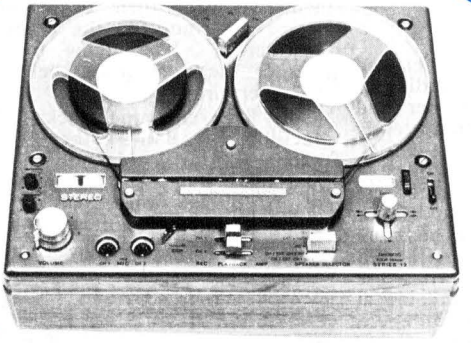
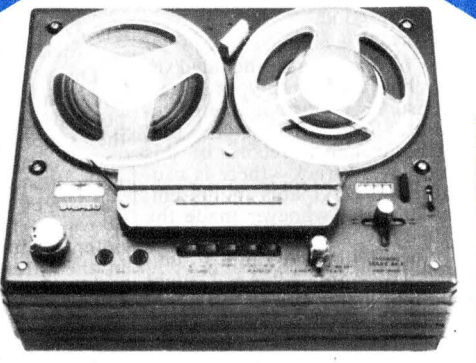


The proven Tandberg "Series 12" Stereo System

Completely solid state, the "Series 12" incorporates twin ten-watt R.M.S. stereo amplifiers, two built-in wide-range speakers, sensitivity for radio tuners and ceramic/crystal cartridges, concentric volume controls and twin electronic beam indicators for positive control of recording level. At 7½ i.p.s., frequency response is 40-20,000 Hz. Signal to noise is 55 dB. This fine recorder is the most advanced self-contained stereo recorder yet released by Tandberg and may be used with confidence as the heart of a complete high-fidelity stereo system.



The new Tandberg 6X Stereo Tape Recorder

This versatile professional-quality stereo tape deck features a new bias head for guaranteed frequency response and unbeatable signal-to-noise characteristics. At 7½ i.p.s. the signal-to-noise figure is an astounding 62 dB.! Frequency response is 20-25,000 Hz. at 7½ i.p.s., a centre channel amplifier permits simultaneous playback of two tracks to mono 'phones. Monitoring is possible both "on" and "off" the tape as well as "sound on sound". Ask for complete specifications at your favourite audio store.

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth Street, Melbourne, Vic. Tel. 63 8101*

Sydney Office: 22 Ridge Street, North Sydney, N.S.W. Tel. 92 3890

INTERSTATE REPRESENTATIVES:

S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1014
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861
Tas.: K. W. McCulloch Pty. Ltd., 109 York Street, Launceston. Tel. 2 5322
A.C.T.: Australian Physical Laboratories, P.O. Box 225, Canberra City. Tel. 4 3010 (Mr. J. E. Howe)
N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801

for Irish songs. The other, "When I Marry Molly Malone" is the work of Harry O'Donovan, brother of the better-known Frank O'Donovan, who wrote the classic "Charladies' Ball," also featured in this selection.

As I have remarked in previous reviews of discs by Brendan O'Dowda, I do not place him in the same class as John McCormack, but he has a pleasant voice and an engaging manner—which I suppose is all that is required for this type of performance. (H.A.T.)

★ ★ ★

ACADEMY AWARD SONGS 1934-45. Frank Chacksfield and his orchestra. Stereo, World Record Club ST-4223. Also available in mono.

Interest: A dozen of the best.
Performance: Smooth, melodic.
Quality: Above reproach.
Stereo: Normal.

It would be a very poor orchestra that could miss out with this group of Oscar-winning songs from the movies—and Frank Chacksfield's is far from being a poor orchestra. On the contrary, I doubt that I've ever heard the songs presented to better advantage: 1934, The Continental—1935 Lullaby Of Broadway—1936, The Way You Look Tonight—1937, Sweet Leilani—1938, Thanks For The Memory—1939, Over The Rainbow—1940, When You Wish Upon A Star—1941, The Last Time I Saw Paris—1942, White Christmas—1943, You'll Never Know—1944, Swinging On A Star—1945, It Might As Well Be Spring.

Not only is the music tuneful and well played, but the quality is absolutely first rate, unspoiled by any trace of surface noise. In short, one I can heartily recommend. (W.N.W.)

★ ★ ★

THE MUSIC OF WALT DISNEY—From Snow White to Mary Poppins, themes taken from the sound tracks. Walt Disney memorial LP, proceeds to be shared between the California Institute of the Arts and the Arts Council of Australia. Buena Vista 12-inch mono, BVS-2000.

Interest: Disney favourites.
Performance: Original sound tracks.
Recording: Variable, but O.K.

Walt Disney must surely have been one of the few real showmen to have appeared to date in the movies' short history. He was certainly the only one to find real success with the animated film. Despite what one might think of his later "ultra-realistic" animated productions, his lavish sentimentality and his "rehash" TV programs, there can be no doubt that his films brought great enjoyment to literally millions of people throughout the civilised world. And very likely they will continue to do so for many years to come . . .

This being the case, there will probably be considerable interest in this Disney memorial disc, which brings back memories of many of his more popular productions. There's "Hi Ho" from Snow White, "Little April Shower" from Bambi, "Zip-A-Dee-Doo-Dah" from Song of the South, "The Work Song" of the mouse chorus in Cinderella, and many others. And, of course, "When You Wish Upon a Star" from Pinocchio, which has almost become the Disney trademark.

The recording is a little variable, as one might expect, but all things considered it's quite O.K. And one could hardly have performances more authentic. So if you would like something with which to remember Disney and his many creations, this would be a good choice. (J.R.)

★ ★ ★

FILM ON FILM—Great Movie Themes, played by Enoch Light and The Light Brigade. Master recorded on 35mm magnetic film. Festival "Project 3" 12-inch stereo, SPJL-932,208. (Also in mono, on PJL-32,208.)

Interest: Recent movie themes, in "Total Sound."
Performance: Sparkling.
Recording: Excellent.
Stereo: Wide, smooth.

This latest recording of movie themes by Enoch Light and the Light Brigade is recorded in the "Total Sound" of Project 3, which would appear to be the successor to the Command concept. Like the earlier enterprise it involves recording the master on 35mm magnetic film, and there is no doubt that this can result in an extremely high standard of recording.

As one might expect from this, the present disc is technically excellent. Bass is smooth, treble light and transparent, and the stereo smoothly spread. But whether the music will appeal or not is probably a different matter; it will depend greatly upon the extent to which one likes one's music "Lightened." Personally, I am beginning to find the Lightening process a little like the Mantovani touch, in that every tune seems to come out much the same. Still, it's to a large extent a matter of taste.

The themes are from: The Sand Pebbles—Born Free—The Alphabet Murders—Who's Afraid of Virginia Woolf?—Alfie—Big Hand for a Little Lady—Hawaii—Is Paris Burning?—The Blue Max—Khartoum—Lady L—How To Steal a Million. (J.R.)

★ ★ ★

BIRMINGHAM JAIL. Slim Whitman. Camden (RCA) stereo CAS-954. Available on mono.

Interest: Country and western singer.
Performance: Pleasing, smooth delivery.
Quality: Good.
Stereo: Reprocessed.

From the seemingly inexhaustible store of country and western material held in its archives, RCA have now released these tracks by popular entertainer Slim Whitman on its economy Camden label. Slim Whitman had a rapid rise to fame in the immediate postwar years, and was for a time regarded as one of the outstanding performers in the country and western field. Little is heard of him nowadays, and he may well still be performing, but the sleeve note does not give any information on this point. From these tracks, it is easy to see why he was a success—he has an engaging personality, and his pleasant voice exhibits none of the straining after high notes which is a common failing of many singers of this type.

With these assets, he delivers the following popular numbers very smoothly: Birmingham Jail—Wabash Waltz—Paint a Rose on the Garden Wall—I'll Do As Much for You Some Day—Let's Go to Church—I'm Casting My Lasso Towards the Sky—There's a Rainbow in Every Teardrop—Tears Can Never Drown the Flame—I'm Crying For You—I'll Never Pass This Way Again.

At the low Camden price, this disc is worth investigating by country and western fans. (H.A.T)

Graeme Bell Says . . .

THE SEVEN AGES OF ACKER: Mr Acker Bilk and his Paramount Jazz Band. Columbia, mono 330EX9178.

Interest: British Trad Jazz.
Performance: Very spirited.
Quality: Not very good.

Recorded in 1959 by one of the leading groups to emerge during the great British trad jazz boom, this album, previously issued on the Columbia label, has now been reissued by E.M.I. in the economy price Encore Series. The Bilk band is never dull—always exciting, and this album is no exception, although, technically, the records made in the 60s show a marked improvement.

Two of Acker's hits are included, namely his arrangement of Ketelby's "In a Persian Market" and one of Mr Bilk's many successful compositions, "Summer Set." There is a very virile rendition of "Tiger Rag," and John Mortimer roars out on his version of Kid Ory's trombone feature—"Ory Creole Trombone." The Bilk band ha always been partial to old march tune and this time we have "Berliner Lu March" from the Gay Hussar and "Ol Comrades March."

Acker's soaring and always fluer clarinet is the strong part of this L.I and, in addition to two of his inimitabl vocals, there is one by drummer Ro McKay on "Let the Light From th Lighthouse Shine on Me." Those wh heard the band in Australia will neve forget being amazed at the latter's swin ing negroid vocal style. This reviewe looks forward to hearing some of Acker recent recordings as, according to recer reports, the style of the band has bee completely changed.

★ ★ ★

COMING ON STRONG—Brenda Le Festival, stereo SDL-932,166. Als on mono.

Interest: Popular vocal.
Performance: Robust.
Quality: Good.
Stereo: Normal spread.

Brenda Lee has been going for a whil now, and listening to this album I wa struck with her versatility. "Upright" an "You've Got Your Troubles" are give belting rock treatment, "Coming o Strong" and the lilting "Summer Wind are pop arrangements, while "Call Me and "What Now My Love" are sun to lively bosa-nova rhythms. There

Three recordings by Fats Waller

1. **FRACTIOUS FINGERING—FATS WALLER. RCA Vintage Series, mono LPV-537.**
2. **HONEY ON THE KEYS—FATS WALLER AND HIS RHYTHM. RCA Gold Standard Series, 45E.P. 20394.**
3. **FATS WALLER ORIGINALS. Universal Record Club, mono U-823.**

Thomas Waller was born in New York, 1904 and died in Kansas City, 1943. He composed dozens of numbers, many still famous, such as "Ain't Misbehavin'" and "Honeysuckle Rose"; wrote complete musical revues such as "Keep Shufflin'" and "Hot Chocolates" which were smash hits on Broadway; appeared in many films; played Bach on the Notre Dame Cathedral organ in Paris; and made over 500 records for RCA with whom he was under contract until his death.

The first album under review is as good a collection of 16 tracks as you would get from this great pianist-entertainer and, I might add, much better recorded than many a disc made today. Three of the tracks are piano solos made in 1929, including a previously unissued take of "Gladyse" and that most majestic version of "Sweet Savannah Sue"—both of them Waller compositions. The other 13 numbers were recorded in 1936 with the members of the Fats Waller Rhythm—Herman Autrey—trumpet, Gene Sedric—clarinet and tenor, Al Casey—guitar, Charles Turner—bass, and Slick Jones—drums—all of whom subsequently became famous.

Tracks include "Nero," "The Curse of An Aching Heart," "Swingin' The Jingle Bells" (a riot) and "Who's Afraid of Love." The whole album is just bubbling over with humour and happiness in contrast with much of today's introspective music and, with its 16 tracks, makes for excellent value. This reissue is produced by Mike Lipskin and remastered by Don Miller. The quality is right up to the excellent standard maintained by RCA's Vintage Series.

The second recording is an E.P. comprising "Honey Hush," "Honeysuckle Rose," "Whose Honey Are You?", and "There's Honey On The Moon Tonight,' which are around the same vintage as the L.P., and once again excellently remastered. The third record, however, suffers by comparison, although Side One gives us a chance to hear Waller's mastery of the Hammond organ. On Side Two he is at the piano, and all of the 12 tracks include a vocal except the waltz from Gounod's "Faust." Some of the other titles are "Loch Lomond," "Oh Dem Golden Slippers," "Hallelujah I'm A Bum," "She'll Be Comin' Round The Mountain," and "Swing Low, Sweet Chariot." Not very exciting material to work on, and Fats sounds rather lonely all there by himself in the studio.

a country and western flavour somewhere, and in "You Don't Have To Say You Love Me" she sometimes sounds like a female Johnny Ray. The two numbers which impressed me most are "Somewhere" and "Kiss Away," where this singer is more thoughtful and gives out, particularly in the former, in true cabaret style. Decca Studios have provided her with excellent studio orchestral backing.

★ ★ ★

CAVALLARO PLAYS ELLINGTON: Carmen Cavallaro, The Poet of the Piano. Festival, stereo SDL-932,109. Also available on mono.

Interest: Melodic piano solos.
Performance: Excellent.
Quality: Crystal clear.
Stereo: Unnecessary.

How sick and tired one can become of the grouping together of tunes by a well-known composer to be used as a vehicle for some jazz musician to de-compose. Often the only look-in the composer gets is on the cover, where his name helps to sell the disc. None of this applies to the album under review, where Carmen Cavallaro sits down at a magnificent piano and extracts all the beauty and dynamics from 12 well-known Ellington tunes. With his pianistic understanding and sensitive technique, Cavallaro has delved deeply and intelligently into the great compositions of another pianist, resulting in a sort of collaboration.

Those of us who, years ago, used to look upon Carmen Cavallaro as a sort of watery Liberace received a very great shock when listening to this L.P. Here is a master of the keyboard—who doesn't profess to be a jazzer—playing with great depth of expression tunes such as "Mood Indigo," "Satin Doll," "Solitude," "I Let A Song Go Out Of My Heart," "Do Nothing Till You Hear From Me," and "Sophisticated Lady."

★ ★ ★

IN THE MOOD: The Mariachi Brass, featuring Chet Baker. Festival, stereo SFL-932,209. Also on mono.

Interest: For Go-Go Dancing.
Performance: Competent.
Quality: Very Good.
Stereo: Very Effective.

Not so long ago we reviewed this group with its album called "A Taste of Tequila," which consisted mainly of Mexican melodies. This latest album, 'In The Mood," consists of 12 of the most popular numbers made famous by the Glen Miller Orchestra, including 'Sunrise Serenade," "Chattanooga Choo Choo," "Little Brown Jug" and "String of Pearls." Practically all of the tunes, including "In The Mood," "Tuxedo Junction" and "Kalamazoo," are given the heavy off-beat rock 'n' roll treatment which sounds rather out of date.

I am not fond of the arrangements by George Tipton, and even Chet Baker's warmly supple flugelhorn fails to rescue these great old tunes from a run-of-the-mill studio treatment. If these tunes must be given an 'up-to-date' treatment, then I'm sure Herb Alpert's sensitivity would bring about a much better result. The recording, however, is excellent, although Baker's flugelhorn needs more presence in "Pennsylvania 6-5000"" ■

TRADE REVIEWS AND RELEASES

LUX SQ-101 AMPLIFIER FROM ENCEL

The Lux SQ-101 is an all-silicon solid-state stereo amplifier, with excellent physical and electrical characteristics and featuring an unusual degree of operating flexibility. It was sent to us for review by Encel Electronics Pty. Ltd., of 431 Bridge Rd., Richmond, Victoria.

The amplifier is complete in a substantial metal case with a brown wrinkle finish. The extruded aluminium front panel has a satin finish while knobs are satin and fawn, with all functions clearly marked.

Overall dimensions are 14¼ inches wide, 5¼ inches high and 9¼ inches deep. The unit gives the impression of robust construction and this is confirmed when the cover is removed, revealing neat design and good workmanship throughout.

The amplifier is of the free-standing type and has been provided with rubber feet for this purpose. Operating facilities are listed in the following paragraphs with appropriate headings and interspersed comment, where appropriate.

Non-technical members of the household could probably confine their attentions to the volume control (top left) and the signal selection switch (top right). The remaining control should meet all likely requirements.

INPUT FACILITIES are provided for: (1) Two magnetic pickups; (2) Input direct from tape-heads; (3) Two auxiliary inputs, suitable for tuner, piezo pickup cartridge or tape after preamplification; (4) Tape monitor. (When recording on a 3-head deck from the amplifier's recording outlets, the recorded signal can be monitored direct from the deck's replay head); (5) DIN tape recorder socket.

All inputs are controlled by a Function switch which selects the input, and a Mode switch giving the option of stereo, stereo reverse, and left or right channel through both channels simultaneonsly. Concentrically mounted behind the Mode switch is a Stereo Blend control giving continuous variation between stereo and mono, and intended to minimise the "hole in the middle" effect on some stereo records.

INPUT SENSITIVITY and EQUALISATION: 3mV for magnetic pickups (RIAA); Tape (7½ips) 1.8mV into 100K (NARTB); Tape (3¾ips) 2mV into 100K (NARTB); Aux. 1, 250mV into 250K; Aux. 2, 500mV into 500K. On test, all sensitivity figures were "spot-on" or slightly in excess of the specifications, allowing generous output from typical magnetic pickups, for example with the volume control at less than half on.

OUTPUT FACILITIES: (1) Stereo loudspeaker system with impedance from 4 to 16 ohms from same pair of terminals (polarity marked); (2) Stereo headphone jack mounted on the front panel with speaker silencing switch; (3) Tape recording outlets, the level of which is independent of volume and tone controls; (4) Two unswitched AC outlets.

CONTROLS (apart from those already mentioned): Volume and Tone controls concentrically mounted; Friction-loaded, concentrically mounted Bass and Treble controls, all continuously variable; Rocker switches for tape monitor, speaker silencing, treble cut (scratch filter), low boost; Push-on push-off power switch lights up with the power on; loudspeaker outlets on the back panel.

The tone controls are unusual in that there are two controls to modify both the bass and treble "corner" frequencies, with facilities to switch each out of circuit to give a flat response. The controls give nominal corner frequencies at 150Hz, 300Hz and 600Hz for the bass control and 1500Hz, 3000Hz and 6000Hz for the treble. In other words, the operator can select not only the amount of boost and cut, but also the range of frequencies whose amplitude is to be modified.

The "Low Boost" switch gives additional bass boost over and above that available from the normal variable controls and, according to the brochure, is intended primarily for low-level listening. The "High Cut" switch also operates independently of the variable controls and is intended for use with old or bad recordings.

In the hands of an audiophile, able to interpret the curves properly, the facilities would accommodate a wide variety of input and listening conditions. Other members of the family may have to be instructed in what not to touch!

FREQUENCY RESPONSE: Measured at a level of 100mW into 8-ohm loads the "3dB down" points were at 25Hz and 60KHz with the tone controls switched out of circuit — most commendable figures. As could be expected, the square wave response at 5KHz was excellent, with no trace of ringing.

POWER OUTPUT: This is specified as 12 watts per channel into 16-ohm loads or 20 watts per channel into 8-ohm loads. These represent RMS ratings at 1 per cent THD and occur above the "knee-point" on the manufacturer's published curves, where distortion is rising steeply. Our own tests indicated 9 watts RMS per channel into 16-ohm loads at 1 KHz and 12.5 watts RMS per channel into 8-ohm loads. This output was obtained with both channels driven to full power, just before visible onset of "clipping," and at approximately 0.5 per cent THD.

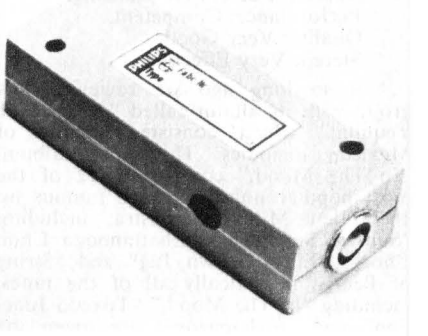
HUM and NOISE: Specifications quote 64dB relative to full output for phono inputs. In a practical situation, when using a typical magnetic pickup at normal listening levels, the residual noise could only be heard very close up to the speakers.

Finally comes the question: "What did it sound like?" Connected to good quality loudspeakers and a typical magnetic pickup, it sounded like any amplifier that is better than its associated equipment and we could have no reason to criticise it on this score. The controls are smooth and positive in action with no trace of backlash or noise. In short, the amplifier is a pleasure to use and worthy of a place in any stereo system.

The Lux SQ-101 amplifier is available from Encel Electronics at $189, complete with handbook containing a full circuit diagram and a set of typical frequency response curves. (L.D.S.).

Oscillator/Modulator

PHILIPS ELECTRICAL PTY. LTD. has introduced a new oscillator/demodulator, Type PR9309, which they say can considerably reduce the cost of relative and absolute displacement measurements in industry and research. The unit operates—in conjunction with a 12V DC supply unit—as a displacement to mV converter, and permits the use of a cheap and simple moving coil indicator instead of a more expensive carrier-wave measuring bridge normally needed for such applications. Such economies are most marked in applications using several displacement transducers, each of which would require its own measuring bridge.



The Type PR9309 allows static displacement measurements in combination with a moving coil indicator or strip chart recorder. Dynamic measuring results can be recorded on a high speed recorder. Measurements up to 100Hz can be made, while a high measuring stability is ensured through a temperature-compensated measuring circuit. The carrier frequency of the unit is 5.6KHz. The adjustable output is ±1V with 10Kohms impedance. Output stability is better than 0.05 per cent in 24 hours.

Further information can be obtained from the company's head office at 69-79 Clarence Street, Sydney.

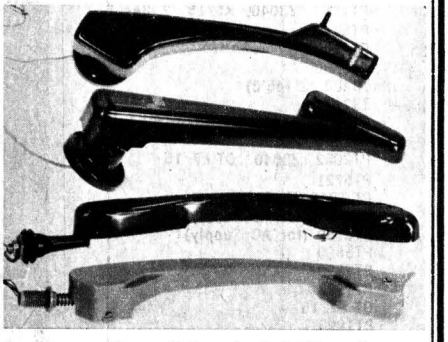
REPLACEMENT PICKUP ARMS

The cheaper type of pickup arm, once so common on dealers' shelves, seems almost to have disappeared. Dealers can supply any number of expensive arms, or complete players but that is all — posing a problem for the hobbyist who want to recommission as old turntable for a secondary role around the home. It is of interest, therefore, to note that Amplion (A'sia) Pty. Ltd. hold quite good stocks of spare pickup arms and are willing to make them available, while they last, on a mail-order basis, for $3 net, including package, postage and sales-tax.

The arms are NOT fitted with cartridges.

The four types available are as pictured and are listed in order, from top to bottom.

G.P.30 — Originally wired and intended for mono cartridges but easily rearranged



for stereo. Overall length 9 1/8in; pivot to stylus position approx. 7 5/8in. Moulded in black, adjustable height, counterweighted at rear. Mounting centres for cartridge ½in, with clearance for cartridges ½in wide.

G.P.10 — Intended for mono cartridges and wired for same. Moulded in black, overall length 9 1/8in; pivot to stylus distance approx. 7½in. Mounting centres for cartridge ½in, with maximum width of 11/16in. Internal spring to reduce playing weight. Movement would need to be freed to use with lightweight cartridges.

G.P.50 — A lightweight arm, our sample moulded in brown. Single-hole mounting pedestal, with internal adjustable tension spring to control playing weight. Overall length 8 7/8in; distance from pivot to stylus position approx. 7 5/8in. Cartridge mounting centres ½in, with room for cartridge ½in wide. Wired for mono but easily adaptable for stereo.

G.P.78 — Another lightweight arm, overall length 8 5/8in; distance from pivot to stylus position approx. 7 1/8in. Sample moulded in grey. Single-hole mounting pedestal with internal tension spring to relieve playing weight; tension adjustable only by modifying spring. Mounting centres ½in for cartridges up to ½in wide. Intended and wired for stereo.

(Amplion (A'sia) Pty. Ltd., 29 Major's Bay Rd, Concord, N.S.W.).

LOW-COST PLANAR TRANSISTORS

FAIRCHILD AUSTRALIA PTY. LTD., announces the availability of three new low cost silicon Planar transistors. The transistors, types AY1101, AY1112, and AY1113, are all priced at 26c each for quantities of 500 up.

The AY1101 is a general purpose NPN silicon Planar transistor which features high power gain, high beta, and low collector cutoff current. The AY1112 is a high beta NPN silicon Planar transistor which is suitable for high gain, low noise audio pre-amplifier stages and direct coupled circuits. The AY1113 is a silicon NPN Planar transistor designed for use in applications requiring very high gain, and is suitable for medium power output driver and low power output circuits. Inquiries should be addressed to the manufacturers at their head office at 420 Mount Dandenong Road, Croydon, Vic.

MODULAR DIGITAL INSTRUMENT SYSTEM

Astronics Imports are Australian agents for a new series of modular digital measuring instruments from Dawes Instruments Ltd. of U.K.

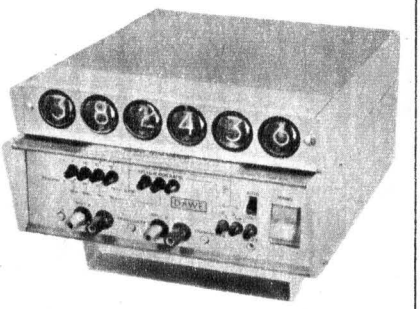
The 900 Series is a range of digital measuring equipment constructed on modular principles—i.e., all units are based on a range of standard modules. In addition, the system includes a range of standard instruments. By combination of modules, special purpose equipment can be provided at comparatively low cost, and almost any measurement can be achieved which involves count, time, rotation speed, or frequency by the correct selection of modules. The system offers considerable advantages in flexibility, since facilities can be extended at any time after purchase of a basic system by addition of component modules. Servicing is also simplified, since component modules can be easily removed and replaced.

All instruments in the range can be supplied as a single deck version, with control and display facilities arranged side by side in a single case suitable for bench or rack mounting (19in); or as a double-deck version in which the display section is separately housed so that the two sections can be mounted "piggy back" fashion, for use where bench space is limited. With this arrangement, the display section can be separated to allow remote display.

The range of instruments currently available in the 900 Series comprises digital frequency meter counter/timers, ratio meters, tachometers and time/frequency calibrators. Further units are to be added to extend the range of applications.

literature describing the units available. This shows how a simple counter with a count rate up to 400KHz can be built up with a stabilised power supply and one or more display counters; speed and frequency measurement unit over the range 1Hz to 1MHz and speeds above 100rpm; time interval measurement unit from 10uS to 100 million seconds; ratio meter (basically a digital frequency meter or timer or counter without a built-in clock generator); measuring systems for various applications.

Further information, technical literature, and details on prices and availability can be obtained by writing to Astronic Imports at 622-626 Nicholson Street, North Fitzroy, N.7, Victoria; or 121 Crown Street, Sydney.



Above: Type 983A digital tachometer, slip speed and gear ratio meter, in the double deck configuration.

Left: Type 960A digital timer, as a single deck unit.

The following general data apply to all units in the series:

- Crystal: 100KHz ± 0.005 per cent.
- Display: 5/8 high, long-life neon numerical indicator tubes; up to six digits can be accommodated.
- Power supply: 95V to 125V, or 195V to 250V RMS.
- Controls: All functions selected by push buttons.
- Temperature range: 0-45 degrees C.
- Case dimensions: Single deck: 17.4 x 2.9 x 11.4in. Double-deck: 9.3 x 4.6 x 11.4in (remote display 9.3 x 1.7 x 10.9in)

A brochure containing more detailed data on the performance of the individual units is available on request.

In addition to the complete digital instruments, Dawes Instruments are making available a range of modules identical to those used in the 900 series described above. All units use printed wiring and plug into standard sockets. A range of switch units, connectors and connector boards is available for inter-unit connection. The range comprises stabilised power supply, display counters, clock generators, double decade divider, control unit, amplifier shaper, inverting buffer, binary display units. These can be used, for example, to produce equipment which might form part of a system, be embodied in other equipment or used to produce a single non-standard instrument. Prices have been kept low by the use of the latest Planar transistor techniques and mass production methods.

Examples of the way these modules can be used to build up systems are given in

FREEZER AEROSOL

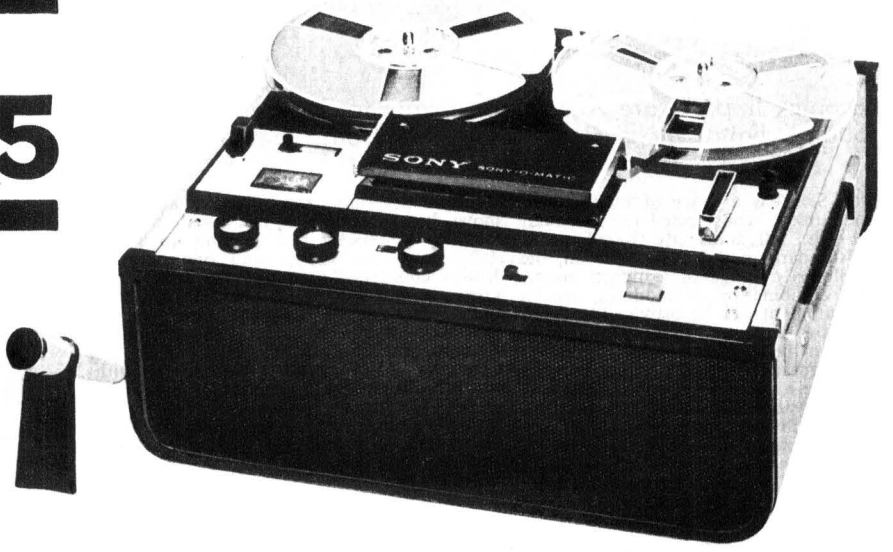
RICHARD FOOT (AUSTRALIA) PTY. LTD. have sent information on Electrolube Freezer, which is a freezer aerosol with a number of applications in electronics work. For example, when a fault such as discontinuity, instability, intermittence or drift occurs in a piece of equipment, this is often the result of temperature rise in some heat sensitive component, particularly those provided as thermal compensators. The Electrolube Freezer aerosol can is provided with a thin tube which allows a fine jet of the freezing reagent to be directed with controlled precision to components in turn, thus allowing the faulty component to be isolated.

Another use for the aerosol is prevention of heat damage to heat sensitive devices such as transistors and diodes. A brief spraying of components with the freezer prior to soldering or desoldering will protect them from the effects of heat for a limited time. Checking and resetting of thermal cut-outs, thermostats and similar devices is simplified by using the aerosol to reduce their temperatures below ambient.

The freezing reagent is harmless to polystyrene and other thermoplastics, is non-toxic and non-inflammable. The aerosol also deposits a protective film over components and connections which inhibits the effects of moisture, such as tarnish or corrosion, which might otherwise result from the formation of ice during the freezing process.

Electrolube Freezer is packed in a 6oz aerosol can, and the retail price is $1.75, including sales-tax.

SONY TC-105



only recorder on the Australian market that gives all these features for $199.50 list

Features ■ Four-track monophonic — 12 hours of recording and playback ■ Reliable all-transistor circuit using Silicon transistors ■ 3 speeds ■ Automatic recording volume control "SONY-O-MATIC" ■ Wide, smooth frequency response and rich output ■ Easy and quick tape loading with "retractamatic" pinch roller and self-threading "SONY-O-MATIC" reel ■ Speaker monitoring and public address facilities ■ Automatic shut-off, instant stop lever with locking facility, digital tape index counter, speaker on/off switch, tone control, voltage selector, professional level meter, etc.

Model TC-105 SONY's new model TC-105 is a versatile four-track monophonic portable tape recorder with truly dependable all-transistor circuit. Designed to meet everyone's purpose and requirements, it also contains professional facilities: 3 speeds, tone control, digital tape index counter, VU meter, lockable instant-stop lever, speaker on/off switch, voltage selector, 7-inch reel capacity, etc. Its extremely narrow gap head assures precise recording in wide frequency range and reproduction of high fidelity with rich 4 W. output from a large, oval dynamic speaker.

SPECIFICATIONS

Power requirement:	100, 110, 117, 125, 220 or 240 V., 50/60 c.p.s. 45 W.
Tape speeds:	Instantaneous selection 7½, 3¾ or 1⅞ i.p.s. (19, 9.5 or 4.75 cm/s.)
Tracks:	4 tracks, monophonic
Recording Time: (With 1800'/550 m. tape)	45 minutes per track, 3 hours in total at 7½ i.p.s. 1.5 hours per track, 6 hours in total at 3¾ i.p.s. 3 hours per track, 12 hours in total at 1⅞ i.p.s.
Reels:	7" (18 cm.) or smaller
Frequency response:	40-18,000 c.p.s. at 7½ i.p.s. 40-13,000 c.p.s. at 3¾ i.p.s. 50-6,000 c.p.s. at 1⅞ i.p.s.
Flutter and wow:	Less than 0.17% at 7½ i.p.s. Less than 0.3% at 3¾ i.p.s. Less than 0.4% at 1⅞ i.p.s.
Record/Playback head:	In-line quarter track
Erase head:	In-line quarter track
Inputs:	Low impedance microphone (1) High impedance auxiliary input (1)
Outputs:	8 ohm external speaker output (1) High impedance monitor jack (1)
Integrated record/ playback connector:	1
Speaker:	4 x 6" (10 x 15 cm.) PM dynamic
Power output:	Max. 4 W.
Transistors:	2SC402 (4), 2SB381 (1), 2SB383 (1), 2SD28 (2)
Diodes:	FRIU (1) IT22 (1) 5G-D (2)
Dimensions:	14¾ (w.) x 7¼ (h.) x 13⅜" (d.) (37.5 x 18.5 x 34.0 cm.)
Weight:	21 lbs. (9.5 kgs.)
Accessories:	SONY dynamic microphone 5" self-threading reel Pre-recorded 5" reel demonstration tape Earphone Connection cord Head cleaning ribbon Splicing tape
Optional accessories:	Telephone pick-up, TP-4S Microphone mixer, MX-600

SONY

Distributors: Jacoby, Mitchell & Co. Pty. Ltd., Sydney & Melbourne.

To: Jacoby Mitchell & Co. Pty. Ltd. 469-475 Kent St., Sydney.
Send me information on Sony Tape Recorders & name of nearest Sony retailer.

NAME.....

ADDRESS.....

.....

EA

TRADE RELEASES—IN BRIEF

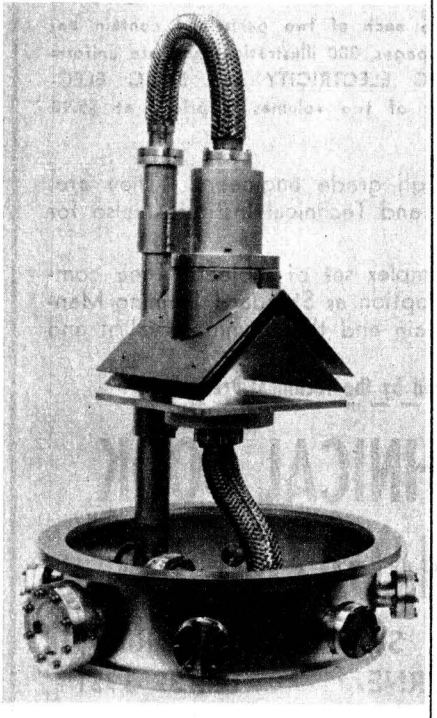
GENERAL ELECTRIC COMPANY, in U.S.A., now has a complete family of gate controlled AC switches (Triacs) following recent additions to its range. These devices are now available with RMS currents from 6A to 15A and for voltages from 50V to 500V.

These Triac switches, which will perform most of the functions of two SCRs connected in inverse parallel, are designed for 120V, 240V and 277V 50Hz or 60Hz switching and control applications, such as lamp dimming and temperature controlling. An outstanding feature of their performance is their ability to withstand high peak one cycle surge forward currents (IFM). In the case of the 6A version, IFM surges of 50A can be tolerated. For the 15A version, the IFM figure is 100A.

Further details and technical data can be obtained from Australian General Electric Pty. Ltd., 103 York Street, Sydney.

STANDARD TELEPHONES AND CABLES PTY. LTD. has announced the appointment of Mr Norman C. Stevens as assistant managing director in charge of the operations of the company's Liverpool plant. Mr Stevens was formerly the general manager of Ducon Condensers Pty. Ltd. The appointment of Mr Stevens has released STC's other assistant managing director, Mr J. B. Scott, from his duties at the Liverpool factory, and he has returned to the company's head office at Alexandria, Sydney.

VARIAN PTY. LTD., 38 Oxley Street, Crow's Nest, N.S.W., has forwarded information on a new 6KW evaporation source designed to provide rapid, ultra-pure thin-film deposition. Virtually all laboratory and production microelectronics and optical coating applications can be served by this device, the company says. The source is easy to install in a vacuum system and can be operated from either on-panel or remote controls. It creates temperatures up to 3500 deg. C which can quickly evaporate a wide range of materials (for example, aluminium at 3750 angstroms/minute and titanium at 10,000 angstroms/minute). The source is compatible with a vacuum down to 1 x 10^{-11} torr and can be baked to 250 deg. C. For purity of film deposition, a tightly focused electron beam is magnetically bent so that it strikes the evaporant which is shielded from bombardment by the heated filament.



Varian RF-Plasmapeak Sputtering System.

Another new instrument from Varian is the RF-Plasmapeak sputtering system, introduced by the Varian vacuum division. This is intended for pure, high-vacuum deposition of any material—metal or dielectric. The sputtering module has a water-cooled target consisting of two square plates set at an angle. These are biased with 1.2KW DC at a radio frequency of 13MHz. Deposition rates on a horizontal 10in sq. substrate holder range from 250 angstroms/minute for dielectrics to 500 angstroms/minute for metals such as copper. A data sheet is available on request.

FERRIS BROS. PTY. LTD., Channel Master Division, has released the Vu-Tron transistorised battery operated booster and distribution amplifier Model 0024-B. This is a single-unit broadband all-channel amplifier of compact design fitted into a plastic case provided with wall mounting feet or brackets. It is intended as a TV aerial booster on boats, caravans, camps, etc., or as a small distributing amplifier in country homes. The unit is self-contained, and provided with leads for connection to 12V-24V and 32V battery supply. It has an inbuilt protective diode, and isolation which allows the unit to be used with floating battery supply, or where positive or negative of the system is grounded. An ON/OFF switch is provided for primary battery operation, but where the unit is connected to a secondary battery it may be left connected continuously if required.

Brief technical data are: Designed for either 75-ohm coaxial cable or 300-ohm line input, output 300 ohms to one to four TV receivers; covers all Australian TV channels, channel coverage 45MHz to 222MHz; gain, 12dB minimum, 16dB maximum; noise figure, 3.5dB minimum, 4.5dB maximum.

Retail price is $35.70, including sales tax. A full range of accessories is available. Further details can be obtained from the company's head office at 752 Pittwater Road, Brookvale, N.S.W., or branch offices in all States.

HEWLETT-PACKARD AUSTRALIA PTY. LTD. has been formed as the local marketing organisation of the Hewlett-Packard company, of U.S.A., effective from July 1. The new company will be under the general management of John A. Warmington, with head office at 22-26 Weir Street, Glen Iris, S.E.6, Victoria, telephone 20-1371. A branch office has been established in N.S.W. at 4 Grose Street, Glebe, telephone 69-6338. Under an arrangement with Sample Electronics, the company's former agents in Australia, the new Australian subsidiary will be staffed primarily with the same personnel who have been handling Hewlett-Packard products at Sample Electronics.

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TECHNICAL BOOK & MAGAZINE CO.

295-299 SWANSTON STREET, MELBOURNE Tel. 32 3951

HANIMEX PTY. LTD., Old Pittwater Road, Brookvale, N.S.W., has released the first batch of Australian made pre-recorded tapes. Hanimex are also currently the only Australian manufacturer of domestic tape recorders.

Hanimex are putting out both two-track mono and four-track stereo tapes on five-inch reels. Retail prices are: mono, $5.59; stereo, $8.50. Among the first released are a selection of titles by Herb Alpert and the Tijuana Brass. They plan to extend the range to include both popular and light classical music, selected from major world catalogues for which Hanimex have exclusive tape recording rights in Australia.

Orders may be placed directly with the Hanimex branch in all capital cities except Hobart. A list of titles in the first release and branch addresses can be obtained from Hanimex Pty. Ltd., at the address given above.

EMERSON AND CUMING, INC., of Canton, Massachusetts, U.S.A., has supplied information on the following products:

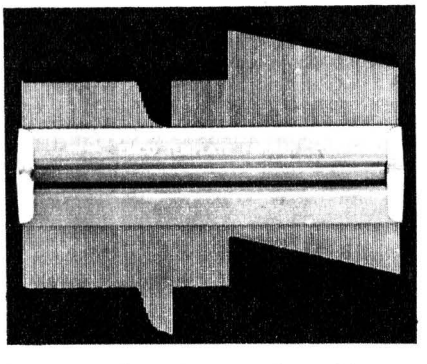
Eccosorb TE are waveguide terminating elements. The terminations, in the shape of bottom-wall wedges, are made from lossy dielectric absorbing material. In use, one side of the wedge is mounted in contact with the bottom (broad) wall of the waveguide. This provides a rugged structure claimed to withstand more abuse than the pyramidal type of structure.

Eccofoam EFF-14 is a one part epoxy encapsulant with a density of about 14 pounds per cubic foot. It is supplied as a powder which is vibrated into the cavity to be filled and then heat treated to effect cure. Cure temperatures as low as 80 deg. C may be used where components cannot be exposed to higher temperatures. Where speed of cure is important, higher temperatures may be used.

Eccobond PDQ is a two part epoxy adhesive that sets within one minute after mixing. The manufacturers state that it is useful for joining metal, glass, ceramics and many plastics where bonding speed if of paramount importance. Small quantities are mixed together and applied immediately to the surfaces to be bonded. The mix ratio is 4 parts of A to one part of B by weight.

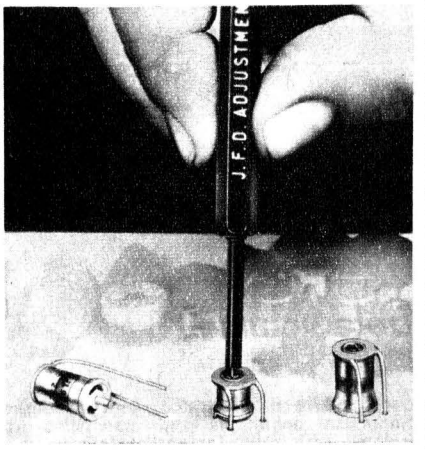
Details are available from the company's Australian agents, Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

THOMAS BUDDEN PTY. LTD., 59 Hume Street, Crow's Nest, N.S.W., advise that the Temco adjustable template former, which has been in short supply for almost a year, is now readily available in Australia. The device comprises a pack of sliding polished steel needles held in a frame by a patent friction device which enables the needles to reproduce accurately and simultaneously a positive and negative profile of any projection or form to which the needles are applied. Each unit allows a profile of approximately 6in to be taken, but a swivel-



ling connecting plate supplied with each unit allows any number of formers to be joined to cope with larger profiles.

The range of applications is said to be virtually unlimited, ranging from ship building to anthropology, architecture to lino laying, tool making to jobs around the home and many others. The device was awarded a gold medal at the last International Inventors' Exhibition, in Brussels. It is sold in two packs—in a plastic wallet and in a blister type pack. Suggested retail price is $4.50 for the wallet pack and slightly less for the blister pack.



DUCON DIVISION of the Plessey Components Group is stocking a new universal top tuning piston capacitor made in U.S.A. by JFD Electronics Co. These are available in two-wire and pin or four-wire configurations for printed wiring board mounting. The unit illustrated has a range from 2pF to 25pF, a working voltage of 500V DC, a Q of 600 at 20MHz and insulation resistance of 10^6 megohms. The tuning torque is 1 to 10 in/oz. Dielectric strength is 1000V. Details of the full range available can be obtained by writing, on company letterhead, to Ducon Components Division, P.O. Box 2, Villawood, N.S.W.

THE PLESSEY CO. LTD. and **THE GENERAL ELECTRIC CO. LTD.** in U.K. have signed a 15-year agreement in the field of public telephone exchange equipment. The agreement provides for: Collaboration in research and development; pooling of facilities to offer countries throughout the world total communications networks, comprising exchange switching equipment, transmission and other telephone plant; both companies to manufacture and sell the 5005 crossbar system developed by Plessey.

The announcement by the companies says they see this as an important measure of rationalisation in the U.K. telecommunications industry. It is expected to provide the conditions to meet better and sooner the technical and production needs of the British Post Office and overseas markets.

MAGNA ALLOYS AND RESEARCH PTY. LTD., 21 May Street, St. Peters, N.S.W., advise that their Corium Chemical Division has produced an insulating material in liquid form which is applied from an aerosol can to form a tough, flexible, oil-proof film. Called Corium 202, the liquid chemical dries within minutes of application. The material when cured is said to have high dielectrical properties which make it a very efficient insulator. Exposed electrical systems can be quickly and economically sprayed with Corium 202 to ensure protective insulation. The product seals out moisture, salt spray, corrosives and undesirable atmospheres. It is said to be ideal for use with diodes, printed circuits, motorhousings, wiring systems, instrumentation and all electrical systems. Dielectric strength is 1000V per mil. ■

TECHNICAL BOOKS AND PUBLICATIONS

Fortran IV — "commendable volume"

INTRODUCTION TO FORTRAN IV PROGRAMMING, by Donald Dimitry and Thomas Mott, Jr. Published by Holt, Rinehart and Winston, Inc., New York, 1966. Soft covers, 6in x 9in, 334 pp., many diagrams. Price in Australia $6.25.

Fifty years from now, if mankind has still not succeeded in vaporising itself, the present era will no doubt be regarded as but the pioneering stage of the computer revolution. Our present machines and computing techniques will likely seem rather quaint and clumsy then, even though they now seem quite complex and refined by comparison with previous facilities. Not only this but the present extent of our application of computing will probably be seen as but a scratch upon the surface of ultimate applications.

It is books like that which forms the subject of this review which will contribute greatly to this progress. Not so much by training professional "programmers," I imagine, but by placing programming knowledge and skills in the hands of the people who will really extend the applications of computing—those with the problems to be solved. It is only when the engineer, the scientist and the artist become properly aware of the potential of computers that the computing revolution will be really under way, and one of the requirements for this to occur are that there will need to be many books to disseminate the basic knowledge.

The present volume is intended as an introduction to what is probably the most widely used programming "language" in current use—Fortran (the name standing for FORmula TRANslation). More specifically, it deals with Fortran IV, the most recent version of the language, in the particular "dialect" used with the IBM 7040-7044 computer systems. However the discussion is sufficiently general to be of considerable value to anyone wishing to develop a basic understanding of other Fortran versions or dialects as appropriate to other machines.

The book is designed to be self-sufficient for the student with no previous detailed knowledge of computers or programming and, to this end, the first three chapters explain in some detail the basic concepts involved in both the digital computer itself and its direction. The first chapter discusses the basic elements and operation of a digital computer; the second discusses number systems and coding; while the third explains the three "levels" of programming languages—machine, symbolic, and machine-independent or "problem orientated," into which latter category falls Fortran.

The remainder of the book then deals with the Fortran language in detail, discussing in turn arithmetic statements, types of variable and constants, functions, transfer and program control, input/output, subscripted variables and DO loops, subroutines, equivalencing and COMMON statements, advanced input/output, logical operations, double precision and complex arithmetic. Finally there are some 25 sample programs and problems, all of which have been tested with a computer to ensure their correctness, and a selected bibliography.

Throughout the text seems very well written. The explanation is clear and concise, and well illustrated with examples. Important definitions and statements are isolated with rules for easy reference at a later date, and every chapter ends with a short set of practice problems.

In short, a highly commendable volume from all aspects, and one which would make an excellent introduction to the Fortran language. It will probably be of value to almost every progressive scientist and engineer.

Our copy came from the Australian and New Zealand distributors for the publisher, Rigby Limited. We understand that copies will be available from the larger bookstores by the time this review is published. (J.R.)

Examples — physics

WORKED EXAMPLES IN MODERN PHYSICS, by P. Rogers, M.Sc., and G. A. Stephens, Ph.D. Vols. 1 and 2. Published by Iliffe Books Ltd., London, 1967. Soft covers, 5½in x 8½in. Volume 1: 126 pp., 12 diagrams. Volume 2: 100 pp., 20 diagrams. Price in U.K. 18/6 each volume.

These volumes are intended primarily for undergraduates in Science and Engineering courses. They contain a selection of actual examination questions from several English universities and colleges and, since English standards are probably broadly similar to those in this country, the examples may accordingly be useful to Australian students in the later years of their courses.

The contents are as listed below:

Volume 1:

ATOMIC and ELECTRON PHYSICS: Mass spectrometers, motion of charged particle in electric and magnetic fields, charge on an electron, photo-electric effect, the Bohr atom, Zeeman effect, etc.

NUCLEAR PHYSICS: Radioactivity, equivalence of mass and energy, nuclear reactions, nuclear reactors, nuclear instruments, etc.

Volume 2:

X-RAYS and ELECTRON PHYSICS: Origin of X-rays, adsorption of X-rays, Bragg's Law, missing orders, etc.

SOLID STATE PHYSICS: Lattice energy of ionic crystals, magnetic properties of materials, point defects, free electron and zone theories, free charge carriers in metals and semiconductors, etc.

WAVE MECHANICS: Dualism, Heisenberg uncertainty principle, Schrodinger Equation, etc.

SPECIAL THEORY of RELATIVITY: Michelson-Morley experiment; the Lorentz transformation.

The books assume that the reader has full knowledge of the topics, and are only concerned with giving a straightforward method for solving the problem in hand. After giving the method for a particular type of problem, further unworked examples with answers are given for exercise. All in all, this book would be very handy to students doing this subject.

Our copy came direct from the London publishers but it is likely that copies will be available from local technical bookstores in the near future. (L.D.S.)

Amplifier Fundamentals

FUNDAMENTALS OF VACUUM-TUBE AMPLIFIERS. Published in U.S.A. by Techpress Inc., Brownsburg, Indiana. Stiff paper covers, 6in x 9in, 308 pp. Price in Australia, $4.75, postage 20c.

This book is a condensation of one of a series of U.S. Navy training manuals covering "Fundamentals of Electronics." Though not divided into numbered chapters, it is nevertheless fairly complete in itself as a study of audio amplifiers, with only passing references to RF amplifiers.

Though the publishers describe it as "basic" and "down to earth," it is very much a book for students, not for beginners. Throughout, the text is heavily dependent on graphs and mathematical expressions. Again, "j" appears without introduction in an elementary treatment of impedance coupling and, later, when equivalent circuits are discussed in some detail, complex numbers are used as a matter of course.

The first section on triode amplifiers includes a very thorough introduction to valve theory. Topics covered include plate-current control, characteristic curves, DC load line and load line analysis, classes of operation, biasing methods, coupling, parameters and equivalent circuits. A large part of this section deals with amplifier frequency response including response curves and deals at some length with equivalent circuits at midband, low-frequency and high-frequency using complex notation throughout.

The second section deals with tetrode and pentode amplifiers, with a quite thorough analysis of gain and frequency response of the latter. The third section deals with paraphase amplifier circuits, or phase splitters as they are more commonly called.

Section four is devoted to the audio power amplifier and although describing both single-ended and push-pull circuits adequately, much of this section is taken up with a description of beam power valves. The final section covers decibels, microphones (including the nature of sound) and the dynamic speaker.

A number of questions are included at the end of each section, but with no answers given. Other questions are scattered indiscriminately throughout the text, with short answers appearing a few pages later, often in mid-sentence, thereby disrupting the smooth reading of the main text.

Review copies were received direct from Techpress; also from the Technical Book and Magazine Co. Pty. Ltd., of 289-299 Swanston Street, Melbourne, C.1, Victoria, who have copies available from stock. (J.H.)

Amplitude modulation

PRINCIPLES OF AMPLITUDE MODULATION. Published in U.S.A. by Techpress, Inc., Brownsburg, Indiana. Stiff paper covers, 6in x 9in, 80 pp. Price in Australia, $2.35, postage 15c.

This rather modest book has been compiled for High-school educated students and is, in fact, endorsed "Not An Engineering Text." It covers the fundamentals of amplitude modulation on a straightforward manner with very little mathematics. Most of the book is purely descriptive, as would be expected in an introductory text of this nature. It should be noted, however, that only AM transmission is discussed, the problems of detection being left out of this treatise.

Some idea of the contents can be derived from the section headings: Amplitude Modulation; Plate-Modulator Analysis; AM-Wave Analysis; Vector Analysis; Additional Modulation Systems. The book is quite comprehensive, but it does emphasise plate modulation in preference to other methods, which are relegated to the last section. The second section describes how to derive a transfer curve and explains the

operation of the plate modulator. The third section includes an analysis of the power in the carrier and sidebands, while the final section includes a brief description of how to check the percentage of modulation.

The book includes a selection of questions at the end of the book as exercises, but gives no answers. It also has a selection of questions in the text of the book with the answers appearing rather disconcertingly several pages later. This tends to disrupt the continuity and therefore does not assist greatly.

Intended primarily for the vast number of "Citizen Band" operators in the U.S., the book should be of some value to Australian hobbyists, amateurs and others who want to learn the fundamentals of amplitude modulation and how modulators work.

Review copies were received direct from Techpress; also from the Technical Book and Magazine Co. Pty. Ltd., 289-299 Swanston Street, Melbourne, C.1, who have copies available from stock. (J.H.)

Elements of Hi-Fi

HI-FI TROUBLES . . . How You Can Avoid Them . . . How You Can Cure Them. By Herman Burstein. Number 120 of the Gernsback Library series, New York. Stiff paper cover, 159 pages, 8½ x 5½ inches, freely illustrated with line drawings.

As an author on hi-fi topics, Herman Burstein will be well known to readers of American technical journals and, in fact, some of the material in this book has been adapted from articles by the author which have already appeared in "Audio," "HiFi Stereo Review" and "Radio Electronics."

The book has been compiled primarily for hi-fi enthusiasts to whom the various major components in a hi-fi system are largely "black boxes." The author makes no attempt to explain the intricacies of circuit design or, for that matter, of component design. In this respect, the title could be misleading to those who might look upon the book as a tutor for repairing faulty amplifiers, etc.

The author's objective rather, is to explain the characteristics and roles of the major components in a hi-fi system, the methods and problems of interconnecting and installing them as a system, and to educate hi-fi enthusiasts into all aspects of their systems, short of actually diving into the innards. There is certainly plenty of scope, even up to this limiting point, and the author appears to have provided an excellent coverage. One thing is certain, if local enthusiasts were to absorb the contents of this book, there would be fewer inquiries about how to connect which to what, and why doesn't it work?

Subjects covered in a total of 11 chapters include, audio troubles, tools of trade, elementary troubleshooting; problems to do with hum, noise, bass, treble, distortion, stereo. A final chapter has to do with build-it-yourself kits.

In short, a most useful book for the uninitiated. Our copy came from the Grenville Publishing Company, 154 Clarence St, Sydney. Copies are available from technical bookshops; Aust. price $4.95. (W.N.W.)

Fourier Transform

THE FOURIER TRANSFORM AND ITS APPLICATIONS, by Ron Bracewell. Published by McGraw-Hill Book Co., Inc., New York, 1965. Hard covers, 6¼in x 9¼in, 381pp., many diagrams. Price in Australia $12.35.

A recent addition to McGraw-Hill's long established and highly esteemed Electrical and Electronic Engineering Series is this volume on the Fourier transform, written by Professor Bracewell of Standford University's school of Electrical Engineering. The author states in his preface that the book is a culmination of an interest in the subject which first started in 1939 when he was a student at the University of Sydney.

The book is aimed at those already possessing a first degree, with the idea of

providing them with a sounder and more basic grasp of the Fourier transform and its applications than is normally acquired "along the way" in post-graduate study. The approach is an honestly practical one, concerned with the application of Fourier transforms to physical situations rather than with furthering the mathematical subject for its own sake.

The original idea was to produce a pictorial guide or "atlas" to Fourier transforms, with diagrams of the appropriate functions and transforms to complement the standard pair lists. However, the author found that as the work progressed the major weight of the content, and the book itself had grown to full-scale text.

Although this might lead one to expect that the book would be unwieldy and rambling, such is not the case; or at least it seems so to this reviewer. In fact it seems to be extremely well written, with a commendable balance between mathematical conciseness and the detailed discussion necessary to fully explain the concepts involved. So successful is this balance that the book seems eminently suitable for the purpose intended.

The chapter headings give a good idea of the scope covered: 1—Introduction; 2—Groundwork; 3—Convolution; 4—Notation for some useful functions; 5—The impulse symbol; 6—The basic theorems; 7—Doing transforms; 8—The two domains; 9—Electrical waveforms, spectra, and filters; 10—Sampling and series; 11—The Laplace transform; 12—Relatives of the Fourier transform; 13—Antennas; 14—Television image formation; 15—Convolution in statistics; 16—Noise waveforms; 17—Heat conduction and diffusion; 18—Pictorial Dictionary of Fourier transforms; 19—Appendix.

Each chapter ends with a set of problems, and chapter 2 includes a bibliography.

To summarise, an excellent text on the Fourier transform and its applications for the engineer and graduate student.

Our copy came from the publisher, but we understand that copies are available at all comprehensive booksellers. (J.R.)

Electron Physics

PHYSICAL ELECTRONICS. Physics Paperback No. 5, by B. Urgosik. Published by Illiffe Books Ltd., London. Stiff paper covers, 189 pages, size 8 x 5¼ inches; numerous diagrams.

The average electronics engineer does not greatly concern himself with the finer details of sub-atomic particles. He assumes their existence, their electrical charge and certain behaviour patterns in vacuum, gas, liquid and solid—but only to a degree necessary to an understanding of electronic components and circuits.

The emphasis of this book is all the other way. The author introduces electron concepts, electron behaviour in metals, electron emission, electron tubes, etc., in much the same manner as one would expect to see in any one of a large number of electronics textbooks; but instead of using this as a starting point to orientate the fact or device in respect to external circuitry, he takes a long, introspective look at the laws and factors which cause the electron to behave as they do.

The publisher's own notes describe the book quite accurately: It begins by discussing methods of producing free electrons and ions and then devotes a chapter to "electron ballistics" in which the motion of charged particles is considered. Succeeding chapters deal with the electron as a particle and a wave, with primary and secondary emission of electrons and the behaviour of electrons in metals and gasses. Electronic optics are considered in some detail and chapters are devoted to electron tubes and mass spectrometers. All the more important aspects of the subject are considered with the exception of plasma, which is the subject of a separate paperback: "Fourth State Of Matter."

(This last-mentioned title was reviewed by I. L. Pogson in our June issue, page 152, and commended for its comprehensive coverage of the subject.)

Published in the first instance, in Prague n 1964, this present English translation :arries the dateline 1966. It is not a preten- ious book and at 17/6 in England is not in expensive one; but it is packed with nformation, freely illustrated with explana- ory diagrams and should be most valuable o engineers and engineering students whose work or studies dictate that they should ay more than the usual amount of atten- ion to what goes on inside thermionic and olid-state devices, from diodes through to conoscopes, magnetrons, klystrons and nass spectrometers.

Our copy came direct from the publishers ut it is reasonable to assume that supplies will be available through technical book- sellers. Price in Australia has not been quoted. (W.N.W.)

Elements of SCR's

ABC's OF SILICON CONTROLLED RECTIFIERS, by Allan Lytel. Originally published in U.S.A. by Foulsham-Sams Technical Books. This edition published in U.K. by W. Foulsham and Co. Ltd., Slough, Bucks, with an introduction for the English reader by W. Oliver. Hard covers, 5¼in x 8¼in, 128pp. Price in Australia, $2.72.

This is a simple introduction to the silicon controlled rectifier, or thyristor. The book covers the following topics in varying amounts of detail: Basic principles, includ- ng semi-conductor theory, how the SCR works and using the SCR; SCR character- stics, including how to read specifications, and turn-on and turn-off methods; Static switching, AC and DC; Phase control, in- cluding magnetic triggers and unijunction transistors; Motor control; Applications of he SCR, including lighting control, and emperature control; Related switching devices, including the four-layer diode and the light-activated SCR.

For the technician, hobbyist, or student who is familiar with transistors, this book will form a useful introduction to SCR's, with its selection of possible applications and experiments.

A few errors have crept in which should be fairly obvious to all but the absolute beginner. One in particular is due to over- simplification in the introducory section explaining semi-conductor theory. Here the author states: "A diode is formed by press- ng together two pieces of semi-conductor material, one p-type and one n-type."

Our review copy came from Grenville Publishing Co., 154 Clarence Street, Sydney. Copies should be available from technical bookshops. (J.H.)

Volumes on Antennas

ANTENNA HANDBOOK by Glanzer, Volume 1: Theory and Practice. Published by Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, N.Y. Soft covers, 8¼in x 5¼in, 109pp., many diagrams. Australian retail price $4.95, postage 15c.

This little book is the first of a set of three volumes. Although we have not seen the other two volumes, it is expected that they will be available shortly. Information available indicates that this work has taken fifteen years of research and preparation and that the approach to the subject is new and not just a re-hash of old material. A careful perusal of Volume 1 seems to indicate that the method of attacking the subject matter is different from the usual and is clear and well presented.

The first chapter is devoted to trans- mission lines and the subject is treated at considerable length. This is a subject that is not at all easy to get across to the reader but this treatment is so well illustrated that there should be no difficulty in grasping this part of antenna theory.

The "characteristic impedance," or Zo, is sometimes found difficult to grasp by some students. Also, the reason why the standing wave ratio differs when measured at the transmitter end, from that measured at the aerial end of the transmission line, is given clear treatment. In short, the author has a thorough grasp of the subject and he is also able to impart it to others.

Chapter two is devoted to antenna funda- mentals. This begins with the theory of radiation and the concept of electric and magnetic fields at right angles to each other. This is followed by a short discussion on radiation resistance. Then follows the half- wave dipole and aerials progressively longer than one half wavelength. Third dimen- sional radiation patterns are given and these give a clear picture of the actual pattern, which is so often lacking when this material is being covered.

The third chapter deals with matching devices. Such methods as the Gamma match, T-match, Delta match, Folded Dipole matching and Quarter-wave stub matching, are included. These are followed by the use of baluns and methods of feeding multiple antennas and stacked beams.

To sum up, I think that this work is well worth looking into and on the assump- tion that the other two volumes are as good, there should be a wealth of information to draw upon, for the reader who has a real interest in antennas. One point however, may stand in the way of some would-be buyers and that is the price. However, this is a matter for the individual to decide.

Our review copy came from the Techni- cal Book and Magazine Company Pty. Ltd., 289-299 Swanston Street, Melbourne C.1, and we understand that copies are now available from stock. (I.L.P.)

LITERATURE—in brief

STANDARDS ASSOCIATION OF AUSTRALIA has issued Australian standard AS K158, covering the quality of electro- plated coatings of gold in engineering appli- cations. The standard provides for 12 coat- ings, ranging in thickness from 0.5 microns to 125 microns. It recognises four types of coating, according to gold content, and spec- ifies hardness, adhesion, porosity and corro- sion restance. Tests for proving compliance with the specified requirements are described, including a method of assessing the com- position of the coating. Copies of the stand- ard are available from the various offices of the association for 80c each, post free.

ADVANCED MICROWAVE TUBES FOR ADVANCED SYSTEMS is the title of a new four-page shortform catalogue produced in U.S.A. by Varian Associates. It lists the complete lines of CEM and ICEM coaxial magnetrons, CW and pulsed crossed-field amplifiers, and high-power noise generators available from S-F-D Laboratories, a subsidiary of Varian Associ- ates. Inquiries should be addressed to the Australian company, Varian Pty. Ltd., 38 Oxley Street, Crow's Nest, Sydney.

ANODEON SALES DIVISION has pub- lished a data sheet covering Anocap polyes- ter film capacitors, now being manufactured by a new division of Electronics Industries Ltd. This lists the full capacitance and voltage ranges at present available, explains how to interpret the numbering code, con- tains typical performance curves and gene- ral information on construction and opera- ting conditions. The sheet is obtainable from Anodeon Sales Division offices at Electronic City, 443 Concord Road, Rhodes, N.S.W.; or Electronics Park, Hamilton Street, Hunt- ingdale, Victoria.

MULLARD OUTLOOK, Vol. 10, No. 2 (March-April, 1967) is a special I.R.E.E. Convention issue, with 24 pages. Articles included are: Philosophy of Mullard Integrated Circuit Data Presentation, which explains the method of presenting data on integrated circuits adopted by Mullard; Integrated Circuit Logic Applications, which deals with the uses for Mullard OMY range of integrated circuits in industrial applications, and has an introduction to logic theory; Integrated Logic Circuits, which gives details of the Mullard OMY100 range of logic devices; Dynamic Display Means Extra Sales. Part 4 — The Interior. (One of a series to assist retailers to understand the principles of good display.)

Mullard Outlook is published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.

MINIWATT DIGEST Vol. 6, No. 6 (March-April, 1967) is devoted entirely to Part 3 of a series of articles on Digital and Logic Systems. Entitled "Applications of Integrated Circuits," Part 3 considers counting in the binary system, and illustrates this by introducing applications of the Philips range of integrated circuits in some counters of various cycle lengths. Practical circuits given are a shift register, decading circuits, and a free-running clock; also a time delay generator constructed from the standard positive NAND gates. Miniwatt digest is published by the Miniwatt Electronics Division of Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. Subscription rate is $3 per volume, post free. Single copies cost 50c each, post free.

WESTINGHOUSE ELECTRIC CORPORATION, Semiconductor Division, of U.S.A., has published the "Westinghouse Semiconductor Replacement Guide, containing a cross reference of power transistors, thyristors (SCR's) and rectifier replacements. Outline drawing showing dimensions of the various configurations available are also included. Inquiries should be addressed to the Westinghouse agents, who are Email Ltd., Joynton Avenue, Waterloo, N.S.W.

STC COMPONENTS REVIEW, Vol. 4, No. 4 (April, 1967) has information on: three new variants of the ITT type 24 and 25 miniature relays — magnetic latching, twin contact and AC versions; miniature aluminium electrolytic capacitors; STC solid tantulum capacitors which are qualification approved by the joint services R.C.S.C.; three ITT silicon diodes suitable for use in power supplies. The same issue also has the continuation of an application note on VHF/UHF power transistor amplifier design, begun in earlier issues. Inquiries to Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W.

NEW DEVELOPMENTS, the new products magazine of Jacoby, Mitchell and Co. Pty. Ltd., describes the following items: Advance Electronics new 2MHz timer counter TC7; PRD Electronics, Inc. thermoelectric power meter Model 6685; Alfred sweep oscillator Model 6400 series; Wiltron Company fidelity test sets, Model 701 (voice bandwidth), Model 332 (envelope delay measurements, 30KHz-5MHz), Model 601B (swept frequency generator, 50KHz-100MHz), Model 350 (LF phase meter, 10Hz-2MHz), Model 321 (phase and amplitude meter), Model 322 (local oscillator, 2.5-100MHz), Model 323 (local oscillator, 100-400MHz), Model 335-336 (wideband FM time delay analyser), Model 310B (multifunction phase amplitude and impedance analyser; TRW Semiconductors new 2GHz UHF transistor Type 2N4976; Sony Model TC-530 tape recorder. Further details can be obtained from the company's head office at 469-475 Kent Street, Sydney.

NATIONAL BUREAU OF STANDARDS in the U.S.A. has advised publication of the following:

Experimental Statistics, by Mary Gibbons Natrella. N.B.S. Handbook 91; August 1, 1963, reprinted October, 1966 with corrections; 544 pages. Price $US4.25. This handbook contains a collection of statistical procedures useful in the design, development and testing of materials; in the evaluation of equipment; and in the conduct and interpretation of scientific experiments. It is intended for the user with an engineering background who occasionally needs to use statistical techniques, but who does not have the time or inclination to become an expert on statistical theory or methodology.

Electrical Parameters of Precision, Coaxial, Air-Dielectric Transmission Lines, by Robert E. Nelson and Marlene R. Coryell. N.B.S. Monograph 96, June 30, 1966; 103 pages. Price $US1.25. This paper provides graphs from which the electrical parameters of lines can be determined rapidly and accurately.

These publications can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Remittances must be in U.S. exchange and should include an additional 25 per cent on the price to cover post charges.

ANODEON SALES DIVISION has available the following technical data:—

Transistor Interchangeability Lists for all popular transistor portable and car radios, including Japanese brands.

Condensed Catalogue No. 10, Semiconductors.

Condensed Catalogue No. 7, Picture Tubes.

Engineering Data 660524, silicon rectifiers AD100 and AD1000.

Engineering Data 280764, silicon rectifiers 1N3659-3660-3661.

Engineering Data 650202, silicon rectifiers 1N3253-4-5-6.

Inquiries to Anodeon Sales Division, Electronic City, 443 Concord Road, Rhodes, N.S.W., on company letterhead.

EMERSON AND CUMING, INC., of U.S.A., has a fold-out chart for notebook or wall mounting which describes the company's range of general purpose and specialty epoxy moulding powders. Information is given on physical form, bulk factors, flow grade and colour choices of the powders, and several applications are illustrated by photographs. Processing conditions, such as the moulding temperatures, pressure and shrinkage are also listed. Mechanical properties of the cured materials listed include maximum operating temperature, tensile, flexural and compressive strengths, and thermal properties. Dielectric constant, loss tangent, volume resistivity and dielectric strength are also given. An application selector table lists a large number of electrical and electronic parts with the recommended powder. Inquiries should be addressed to the company's agents, Wm. J. McLelland and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

BBC ENGINEERING MONOGRAPH N0. 66 (February, 1967) entitled "VHF aerial gain calculation using tables of mutual resistance between the radiating elements," has been published by the BBC, in London. The authors are P. Knight, B.A., M.I.E.E. and R. E. Davies, M.A. The text covers: Gain computation from mutual resistance — The computation of relative mutual resistance for vertical radiating elements, tangential radiating elements and radial radiating elements — The gain of a single element — Verification of the method of computation.

The monograph can be obtained from BBC Publications, 35 Marylebone High Street, London, W.1. The price is 5s post free.

RF POWER TRANSISTORS is a quick selection guide and graph for RF power transistors featuring overlay construction, and includes both RCA and J.E.D.E.C. designations. Copies can be obtained from Amalgamated Wireless Valve Co. Pty. Ltd., of 348 Victoria Road, Rydalmere, N.S.W.

"QUARTZ CRYSTAL UNITS" is a booklet giving details of the Pye range of crystals and explaining how to specify and order these crystals. Copies are available free on request from Pye Pty. Ltd., Crystal Division, 59 Arundel Street, Forest Lodge, Sydney, N.S.W.

AMATEUR BAND NEWS AND NOTES

"Australis I" Satellite Shipped to U.S.

The Australian Amateur Satellite AUSTRALIS I, now officially known as "Australis Oscar A," was shipped to the United States on June 1.

By Pierce Healy, VK2APQ*

The "Australis Oscar A" amateur radio satellite, built by the Melbourne University Astronautical Society and the Melbourne University Radio Club, was airfreighted to San Francisco for delivery to Project Oscar. Three members of the Project team from the Melbourne University, Messrs Paul Dunn, Owen Mace and Richard Tonkin, will accompany the satellite to the United States. They will conduct special tests on the satellite, as well as having discussions with officials of Project Oscar.

The departure of the satellite for the U.S.A. comes just 15 months after the final design was approved. The satellite has been built on an entirely voluntary basis — none of the constructors received any payment for the work they did on the project. Also most of the electronic components used in "Australis Oscar A" were donated by Australian firms. The Wireless Institute of Australia gave the project a $400 grant for the purchase of special materials and components, and the Melbourne University Union gave a special grant of $750.

"Australis Oscar A" is a 35 pound rectangular satellite, measuring 17 inches by 12 inches by 6 inches. The aluminium case has been specially strengthened to withstand the acceleration and vibration of the launching into orbit. The satellite will be thermally controlled by a black and white paint pattern, which will be applied in the U.S.A. It is hoped that the internal temperature of the satellite can be kept within a range of 60 deg. to 100 deg. F, although all units have already been tested from 20 deg. to 200 deg.

"Australis Oscar A" is a test bed for systems that will be used in later amateur radio satellites. It will transmit information on the performance of these systems to amateur radio tracking stations around the world. The telemetry system in the satellite has been specially designed so that radio amateurs can decode the information transmitted from Australis Oscar A, using relatively inexpensive equipment. It will take only a few minutes to decode this information using charts which will be supplied to all radio amateurs tracking the satellite.

The satellite carries two transmitters operating in the international amateur radio bands. One transmitter operates on a frequency of 144.050MHz. This transmitter has an average output of 100 milliwatts and will operate continuously from the time the satellite is put into orbit until its batteries are exhausted, about two months after launch.

The second transmitter operates on a frequency of 29.450MHz, and has an average power output of 250 milliwatts. This transmitter will be commanded to switch on and off by a number of specially equipped amateur radio tracking stations. This will be done to conserve the satellite's batteries as the transmitter puts a heavy load on the batteries.

"Australis Oscar A" is the first amateur radio satellite to carry this type of command system and to carry a transmitter operating the 29MHz band. This band is of particular interest to radio amateurs, as it can be used for international communications. It is hoped that, by studying the signals from the satellite's 29MHz transmitter, more can be learnt about which times of the day and seasons of the year are most suitable for using the 29MHz band for long distance communications.

The telemetry system in the satellite converts data (produced by sensors) such as battery voltage and temperature into audible tones. These tones are then fed to the two transmitters which relay the information to radio amateurs stations on the ground. This telemetry unit is also linked to a keyer, which produces the letters "HI" every 60 seconds.

The satellite carries seven sensors which are fed into the telemetry system. These consist of three horizon sensors, a battery voltage sensor, a battery current drain sensor, a battery temperature sensor and a sensor attached to the inside skin of the satellite. Each sensor is sampled for 7½ seconds. At the end of the seventh tone, two "HI's are sent, and then the whole sequence is repeated.

The command decoder and receiver system in "Australis Oscar A" will receive specially coded signals from a number of amateur radio tracking stations. These signals will be used to switch the 29MHz transmitter on and off, to conserve battery power.

A magnetic attitude stabilisation system (MASS), which consists of a permanent bar magnet and hysteresis rods, will stabilise the satellite. This should reduce the effect of signals fading, as the satellite orbits the earth. "Australis Oscar A" is the first amateur radio satellite to incorporate such a system.

It is hoped that "Australis Oscar A" will orbit the earth at a height of about 500 statute miles, with an inclination to the equator of approximately 70 degrees. This would mean that the satellite would orbit the earth once every 103 minutes and it would complete 15 orbits every 24 hours. Although the radio equipment will operate for about two months, it is expected that the satellite will remain in orbit for 50 to 100 years.

Project Oscar Inc., is a California-based organisation of radio amateurs. They have built four amateur radio satellites since 1961. All of these have been successfully

***News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**

10th Jamboree-on-the-Air

The 1967 Scout Jamboree-on-the-Air, the tenth to be held, has been scheduled for the period 0001 hours GMT on Saturday, August 5th to 2359 hours GMT Sunday, August 6th. This coincides with the holding of the XII World Jamboree in Idaho, U.S.A. and also with the 60th Anniversary of the first experimental Scout Camp on Brownsea Island, England in 1907.

In celebration of Scouting Diamond Jubilee, Scouts throughout the world are planning special camps during this period and it is hoped most, if not all, will be equipped for the weekend of the 5th and 6th August with an amateur station "linking" them with stations both at the World Jamboree and on Brownsea Island.

As in the past no doubt many more members of Scouting groups will be invited by amateur radio operators to participate in the J.O.T.A. from the operators' home stations. The World Bureau Scout station VE3WSB will not operate during this J.O.T.A. Instead, its place will be taken by K7WSJ, operating from the Jamboreee site at Farragut State Park, Idaho, U.S.A.

The station will operate continuously during the 48-hour period of the Jamboree-on-the-Air, using three complete stations. The following frequencies will be used, according to band conditions.

Band	CW	Phone (SSB)
80 metres	3525KHz	3950KHz
40 metres	7025KHz	7290KHz
20 metres	14025KHz	14290KHz
15 metres	21025KHz	21290KHz
10 metres	28025KHz	28590KHz

A special station will operate from Brownsea Island, using the call sign GB3BS1. The originator of the Jamboree-on-the-Air, Les Mitchell, will be in charge of this station. Both stations will issue special QSL cards to all stations they contact.

Official emblem of the Jamboree-on-the-Air.

The following are call signs of Scout-operated amateur stations in Great Britain — GB3BPH and G3TGS in London (Baden Powell House); G3TZR in Liverpool; G3MVH in Halifax; G3RSS in Rastrick; also G3BHK, G2CAJ, G3FXC, G3SDG, G3VNU, G3VQR, G3VHK, G3VJL and G3VKZ.

During the 9th J.O.T.A. held on October 1966, the World Bureau Official Station, VE3WSB recorded contacts with the following Australian call signs: VK6RU, VK5LC, VK5NM, VK3SD, VK2AFY and VK9XI.

In recent years, participation by Australian amateurs has been among the highest in the world, and contacts with Australian stations are eagerly sought after. The event enables many young people to be introduced to amateur radio and has been a means of excellent publicity for the amateur service.

The Wireless Institute of Australia, along with kindred bodies throughout the world, recommends participation by members in the Jamboree-on-the Air. All that is necessary to participate is to contact a local Scout group or District Scoutmaster and either arrange for members of the group to visit your station, or to set up portable equipment at a Scout Hall or camp site. Scouts are very adept at erecting antennas.

The event is not a contest but rather a means of allowing an exchange of greetings between local and overseas Scouting groups by means of amateur radio.

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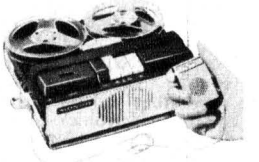

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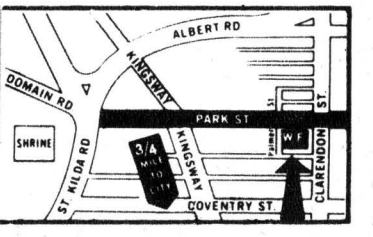

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launched into orbit. Oscar I and II were beacons which relayed temperature data to earth. Oscar III and IV were fitted with communications repeaters which were used by radio amateurs to relay morse and voice messages across the Atlantic and Pacific oceans.

The "Australis Oscar" project team have kept in close contact with Project Oscar Inc., during the construction of the Australian satellite. Project Oscar Inc. has agreed to negotiate with United States launching authorities for a ride into orbit for the "Australis Oscar A" satellite.

It was not known at the time of preparing these notes when the launching is likely to take place. When this information comes to hand, details will be given over all official Wireless Institute stations and local news services.

Project Australis gratefully aknowledges the kind assistance of the following organsations, without whose help the construction of the satellite would not have been possible:

Acme Engineering, Melbourne (radio frequency connectors) — Cannon Electric (Aust.) Ltd., East Brighton, Melbourne (resistors and connectors) — Ducon Condensers Pty. Ltd., Villawood, N.S.W. (all capacitors used in the satellite) — Fairchild Australia Pty. Ltd., Croydon, Melbourne, (all transistors and diodes used in the satellite) — The Potter Foundation, Melbourne (travel grants to Project Oscar Inc. in the U.S.A. for two persons)—Pye Pty. Ltd., Melbourne (all radio frequency crystals used in the satellite). — Rola Co. (Aust.) Pty. Ltd., Melbourne (magnetic attitude stabilisation system magnet)—Sample Electronics, Melbourne (circuit boards) — Turner Industries Ltd., Melbourne (satellite antennae)—Union Carbide Australia Ltd., Sydney (flight and backup battery packs). — Plessey Components Division also gave a travel grant for a third person to accompany the satellite to the United States.

Thanks are also extended to the Meteorology Department of the University of Melbourne and the Bureau of Meteorology, Melbourne, who have been most helpful over the past 15 months.

R.S.G.B. DX Contest Result

The results of the Fifth R.S.G.B. 7MHz DX contest held late last year do not reveal a great interest on the part of amateurs in Oceania. In the CW section three logs were submitted by Australian stations, while in the telephony section only one call sign appeared.

In the CW receiving section of the contest the first and third places were taken by Australian Short Wave Listeners. The winner of the CW section was — A. J. Slater G3FXB 3447 points. Australian station positions were:—

50 P. J. Dettman VK3APJ 850 points
66 J. E. De Cure VK5KO 700 points
124 I. Stafford VK3XB 400 points

Total logs received — 138.

In the telephony section the winner was: R. Gibson G13OQR 2997 points

In a total of 37 logs submitted, last position was occupied by: I. Stafford VK3XB 200 points.

In the CW receiving section:
George Allen, West. Australia, 1740 points.
Eric Tribilcock, Victoria, 1300 points.

The 1967 R.S.G.B. 7MHz contests are set down for Telephony Section, 28th-29th October. Telegraphy Section 11th-12th November.

Rules for the contest will be given in the October issue of these notes.

21MHz and 28MHz Contest

The 1967 21MHz and 28MHz R.S.G.B. Telephony contest will be held on the 14th and 15th October. Rules for this contest will appear in the September issue of these notes. With conditions improving on these bands there is reason to anticipate some very good contacts during the contest.

WIRELESS INSTITUTE ACTIVITIES

A booklet entitled "How to Become a Radio Amateur" is being prepared by the Federal Executive of the Wireless Institute of Australia. This will give the person who desires to obtain an amateur operator's licence, all the details on the assistance the Institute can offer the prospective amateur. It will also answer many questions about amateur radio including those generally asked by those preparing themselves for the required P.M.G. examination.

Copies of the booklet may be obtained by writing to the Federal Secretary, Wireless Institute of Australia, Box 2611W, G.P.O., Melbourne.

NEW SOUTH WALES

The council of the New South Wales Division has instituted a membership drive. The aim is to extend to amateurs living within the State who are not already members, an invitation to join the institute. Already more than 50 per cent of the licensed amateurs are members and it has been suggested that each member should endeavour to obtain one new member.

An increase in membership will allow an increase in the services and facilities available to members. Details of membership fees and other information can be obtained by writing to the Secretary, N.S.W. Division W.I.A., 14 Atchison St, Crows Nest.

Hunter Branch

The lecturer at the May meeting of the Hunter Branch was Lionel Dooland, VK2-ZLD, well known as a lecturer of Electronics at the Newcastle Technical College. He chose to speak about "Professionalising Amateur Equipment" and his lecture was a very practical one which outlined the various methods of metal treatment and construction.

In addition, he showed several completed items of equipment which employed the techniques described. One of the largest audiences in recent years, 50 members and visitors, attended the lecture. As has become the policy, the meeting commenced with a colour film. The topic on this occasion concerned the manufacture and use of printed circuits.

The July meeting which is to be held in Room 6 of the Clegg Building, Newcastle Technical College, will be addressed by Gordon Sutherland, VK2ZSG, who has the reputation for reworking the popular "Command" series receivers, will outline his most popular conversions, including one for double conversion to improve selectivity.

The meeting, which commences at 8 p.m. will feature a film of interest to amateurs and short wave listeners. The Hunter Branch President, Frank Boundy, VK2ZFX, extends a welcome to all radio enthusiasts in the Newcastle area to be present at this and any Hunter Branch meetings. The meetings are held regularly throughout the year on the first Friday of each month.

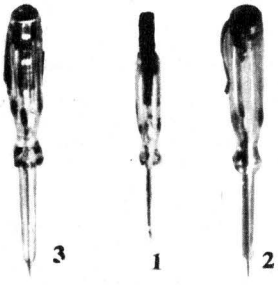
Several Newcastle amateurs were hosts during May to Nubuo Matsukura who as JA3API/MM is well known to operators on the 80 and 40-metre bands. Nubuo was making a short visit to the city while his ship London Maru was in port. The amateur station operated by Nubuo has a power input of 25 watts to a long wire antenna and has tallied up the impressive total of 188 countries while mobile marine. He usually operates on 3550KHz between 0800 and 1200 hours GMT while in Australian waters.

RADIO HOUSE PTY. LTD.

306-308 PITT ST., 6 ROYAL ARCADE AND 760 GEORGE ST., SYDNEY

SPECIAL PURCHASE

Set of three posted $3.75



CHROME VAN

German screwdriver and pocket tester.

1. 6-12 volt model auto test.
2. Sparkplug tester.
3. 110-380 volt mains tester.

$1.25 each

Actual Size

"KEY LITE" $3.95

Free. One spare mercury cell.

With fob keyring, attractive gold finish case. Simply squeeze. Illuminates car and house locks, etc.

$4.00 Posted anywhere

MULTIMETER TESTERS

Model RH-50

Modern Design, 33 Micro Amp Meter.

30,000 Ohms per Volt D.C.

13,000 Ohms per Volt A.C.

1 p.c. Multipliers and Shunts used, Printed circuit.

Clear Scale, rugged moulded case.

SPECIFICATIONS

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 Ohms per volt.

AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.

DC Current: 0-.06-6-60-600 mA, 0-12 A.

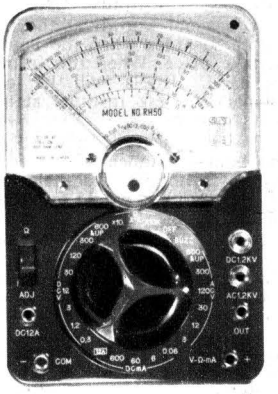
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).

Decibels: minus 20 to plus 57 dB (0 dB equals 1 mW. 600 ohms).

Audio Out: Capacitor in series with AC volt ranges.

Short Test: Internal buzzer.

Accessory: 1 pr. heavy test leads.



Price $31 (£15/10/)

with leather case, $38.00. Postage 50c to $1 extra.

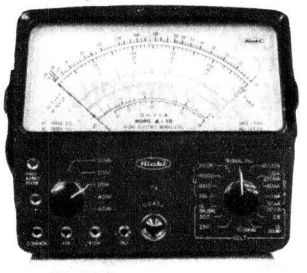
Batteries: 1 (1.5V), 1 (15V).

Size: 3 5-16" x 6 5-16" x 2¼"

Weight: 1.4lb approx.

NEW MODEL A-10 MULTIMETER AND SIGNAL INJECTOR

With Test Leads and Injector Probe



30,000 o.p.v.

SPECIFICATIONS: 6in x 2½in scale.

DC Voltage: 0-0.5, 2.5, 10, 50, 250, 500, 1,000V at 30,000 o.p.v. 5,000 and 25,000 V at 10,000 o.p.v.

AC Voltage: 0-2.5, 10, 50, 250, 500, 1,000 V at 10,000 o.p.v.

Volume Level in Decibels.

DC Current: 0-50 uA, 1, 50, 250 mA, 0-1 and 10 amps.

AC Current: 0-1, and 10 amps.

Resistance: 0-10K, 100K, 1M, 100 Megohms. Signal Injector Output Jack. Zenor Diode Overload Protection.

Price $60.00

LIMITED STOCK ONLY

Model RH-10

RANGES:

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

AC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

DC Current: 0-500uA 0-500 mA.

Resistance: 0-10K-1Meg: 60 ohms, 6K ohms at centre scale.

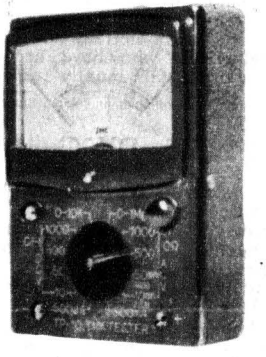
Capacitance: 250uuF to 1uF, in two ranges.

Decibels:—20 to plus 36db, two ranges.

Output; 0-1,000 V in four ranges.

Size: 5in x 3½in x 1½in.

Weight: 13oz approx.



Price $10.75 (£5/7/6)

Postage 50c to $1 extra.

TRANSISTOR HEARING AID

First Phone Model 3 Transistors

This Hearing Aid is an ultra-modern unit. It incorporates the following outstanding features:

Ample power and clear tone.
Compact,
Precision printed circuit design.
Magnetic earphone.
Separate Tone and Volume Controls.
Standard size torch cell.
Packed in a presentation case.

New Model $31.50

Replacement Battery only 12c.
Postage 50c extra.

Model RH-5

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

SPECIFICATIONS

DC Voltages: 0-10-50-250-500-1000 V (20,000 Ohms/V).

AC Voltages: 0-10-15-250-500-1000 V (10,000 Ohms/V).

DC Current: 0-50uA, 0-5-50-500mA.

Resistance: 0-10K, 0-100K, 0-1Meg, 0-10 Meg. (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).

Capacitance: 0.0001uF-0.005uF, 0.05uF-1uF.

Decibels: minus 20db to plus 36db in 2 ranges.

Dimensions: (3½in x 5¼in x 1¾in).

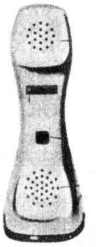
Weight: 15oz approx.

Price $18 (£9/-/-)

Postage 50c to $1 extra.

Complete with internal battery, testing leads with prods.

TRANSISTOR POWERED TELEPHONE



$12.00 each

any number can be connected together.

Latest Stand type with Call Button on each unit.

Ideal for office or home installation.

WANTED

SALESMAN FOR OUR RADIO ELECTRICAL COUNTER

Enquiries phone 61-3832 or write to 306 PITT STREET, SYDNEY

Muswellbrook Amateur Radio Club

The inaugural meeting of the Muswellbrook Amateur Radio Club was held on May 4, 1967. This club, which is affiliated with the N.S.W. Division, will serve amateurs and intending amateurs in the Upper Hunter districts.

Officers elected were:

President: Ken Mitchelhill, VK2ANU.
Vice-president: Les Baber, VK2RJ.
Secretary: P. J. Charlton.
Treasurer: H. Ewen.
Committee: K. Miller, J. Woods, J. Timkins, N. Cameron.

QUEENSLAND

The Townsville Amateur Radio Club meetings are held on the first Thursday of each month at 8 p.m., in the Auditorium of Radio Station 4TO, Townsville. At the May meeting, members discussed the possibility of participating in the "Australis" satellite project. From the enthusiasm shown it seems certain that the Club will be supporting such a scheme.

Lance Noseda, VK4ZMI, has been elected official Class Instructor and now has two classes under instruction. These are held on Saturdays at the 4TO auditorium. Elementary classes are held from 8.30 a.m. to 10 a.m. and advanced classes from 10 a.m. to 11.30 a.m.

SOUTH AUSTRALIA

The May issue of the South Australian Division's journal contains some interesting details on the use of FET transistors. Written by Rick Matthews, VK5ZFQ, the article gives information on the use of these devices in VHF convertors. The journal is circulated to all financial members of the division. An invitation is extended to licensed amateur operators, who are not already members, to join the division. Applications for membership should be made to the Secretary, W.I.A., South Australian Division, Box 1234K, G.P.O., Adelaide.

WESTERN AUSTRALIA

At the Annual General Meeting of the Western Australian Division, held in April, the ballot for the 1967-1968 council was held. The office bearers for the ensuing year are:

Patron: W. G. Hayman, VK6GH.
President: R. Chamberlain, VK6RY.
Vice-President and Technical Officer: V. J. Kitney, VK6VK.
Vice-President and Bulletin Editor: W. G. Wylks, VK6WY.
Secretary and Federal Contest Manager: N. R. Penfold, VK6ZDK.
Treasurer: K. Moore, VK6ZBT.
Broadcast Officer: R. Elms, VK6BE.
Youth Club Co-ordinator: Rev. Bro. J. Morgan, VK6RT.
V.H.F. Officer: L. Jessop, VK6ZEA.
Program Organiser: G. Sturcke, VK6ZEZ.
QSL Officer: J. Rumble, VK6RU.
Bulletin Distributor and "A.R." Sub-Editor: R. Greenway, VK6DA.

In the annual report the retiring president V. Kitney, VK6VK, referred to the increasing membership of the division, the high level of attendance at general meetings and the need to give serious consideration to the formation of a Region III conference.

W.A. VHF Group

Amateur television test transmissions were reported to be taking place on the 432MHz band in Perth and to assist those who desire to receive these signals, the details for the construction of a 432MHz convertor has been published in the May issue of the VHF group bulletin. The convertor is to be used ahead of a standard TV receiver and costs approximately $3 to build. Two type 2N2563 or 2N3564 transistors are used.

The group's club station operates beacon transmitters on 52.006MHz and 144.198MHz continuously with automatic CW identification call sign VK6VF, with approximately 4-second key-down position between call signs.

Members of the group meet on the fourth Monday in each month in the D.C.A. Workshop canteen, 86 Guildford Road, Maylands, at 8 p.m. Visitors are welcome to attend.

R.S.G.B. NEWS

The editorial in the April edition of the Radio Society of Great Britain bulletin draws the attention of British amateurs to the Wireless Telegraphy Bill published at the beginning of March. It is pointed out that the sweeping blanket powers conferred on the Postmaster-General by Part II of the Bill, if passed by the British Parliament in its present form and placed on the Statute Book, could place the very existence of amateur radio in jeopardy.

"The heading of Part II is innocuous enough — 'Miscellaneous' — but the side heading should give the red light — 'restrictions of manufacture or importation of certain apparatus.' Under section 7. (1) and (2) of the Bill if the PMG 'specifies' apparatus, no person shall manufacture, whether or not for sale, any apparatus of that class or description; and the importation of apparatus of that class or description is prohibited.

"The only limitation placed on the powers of the P.M.G. to specify equipment is that it must be related to 'interference,' which could be extended logically to include any form of receiving, test or transmitting equipment containing an oscillator. It will be seen that not only may one not buy 'specified apparatus' but also it may not be built, so that by carrying the possibilities to their full limit you could be in serious trouble by constructing a grid dip oscillator.

"It will, of course, be said that the P.M.G. would never use his sweeping powers to prohibit amateur equipment, but what P.M.G. would consider himself bound by the words of his predecessor in another government. Many reasons could be found for a change of policy. No, this is not the answer, which lies in a nation wide effort to prevent this Bill from becoming law in its present form.

"Have our friends who advertise in the pages of the 'Bulletin' considered the possible effect on their trade if this consists mainly of selling components to the thousands of constructors throughout the country Restrictions in the types of equipment which may be built in the home workshop — note the words — whether or not for sale — could put them out of business."

Other comments refer to the power to prohibit importation of wireless apparatus as presumably designed to restrict the flood of walkie-talkies which are now causing interference to television receivers. Members of the R.S.G.B. are also urged to record their disapproval of the Bill in its present form, to their Members of Parliament.

I.T.U. NEWS

The 22nd session of the Administrative Council of the International Telecommunication Union opened on Saturday May 6th at the I.T.U. Headquarters in Geneva, Switzerland. The session continued until May 27th. The Council consists of the representatives of 29 countries, who were elected from among the members of the Union at the Plenipotentiary Conference held in Montreux, Switzerland, in 1965. These countries are as follows.

Region A (Americas): Argentine Republic; United States of America; Canada; Mexico; Republic of Venezuela; Brazil.

Region B (West. Europe): France; Italy; Confederation of Switzerland; Federal Republic of Germany; United Kingdom of Great Britain and Northern Ireland; the Channel Islands and the Isle of Man; Ireland.

Region C (East Europe and North Asia): Union of Soviet Socialist Republics; Federal Socialist Republic of Yugoslavia; Peoples Republic of Poland.

Region D (Africa): Kingdom of Morocco; Republic of Dahomey; Federal Republic of Nigeria; Algerian Democratic and Popular Republic; Ethiopia; Malagasy Republic; Uganda.

Region E (Asia and Australasia): Japan; Commonwealth of Australia; Republic of India; Pakistan; Lebanon; Kingdom of Saudi Arabia; China.

At its first Plenary meeting the Council elected as chairman Mr Proinnsias L. O. Colmain (Ireland), who had been vice-chairman of the 21st session in 1966, and Mr Henryk Baczko (People's Republic of

Poland) as vice-chairman. It also appointed chairmen and vice-chairmen for the three committees (Finance, Staff, Technical Co-operation).

The meeting was opened by Mr Rudolf Rutschi (Switzerland), chairman of the 21st session. Mr Rutschi, welcoming the delegates of the 29 member countries of the Administrative Council, recalled the sad event of 19th February 1967, when Dr M. B. Sarwate, Secretary-General of the I.T.U., died. He invited the meeting to observe a one-minute silence in memory of Dr Sarwate. He also recalled how Mr Mohammed Mili (Tunisia), Deputy Secretary-General, had taken over the duties of Secretary-General ad interim, in accordance with the International Telecommunication Convention (Montreux 1965).

Mr P. L. O. Colmain, the new chairman of the Administrative Council, then thanked the meeting for the honour conferred on his country and himself by his election to such important duties. After reviewing the program of work facing the present session, he invited the council to pay tribute to the memory of former participants who had died since the previous council session. Mr H. Baczko, the new Vice-chairman, likewise thanked the Council.

Mr Mili, Secretary-General ad interim of the I.T.U. welcomed the members of the Council and reviewed the various administrative and technical problems raised by Union activities. He emphasised that "as it embarks on this second century of its existence, there is no doubt that the two main problems facing the I.T.U. are those of technical co-operation and space telecommunication."

VHF DX ACTIVITY

Two letters giving some most interesting details of the VHF band conditions in northern Australia have been received. Writing at the beginning of May, Peter Lindsay, VK4ZPL, of Townsville, Queensland, stated:—

"As the Australian Sporadic E, 6 metre DX faded in February, the 52MHz band opened to the north and has been open every day since. While I expected these northern openings to last only until mid-April, it is now well into May and the openings are just as strong and consistent.

"The variety of stations that can be received at this location is amazing. FM sound stations can be heard between 48MHz and 49.5MHz. Meteor scatter stations appear between 49.5MHz and 50MHz. JA, KA and JH stations operate between 50MHz and 52MHz, with by far the greatest number operating within the first 500KHz of the band. In addition in this 2MHz section JA radio-telephone services and JA-IGY stations can be heard.

"JA stations have been heard as high as 52.7MHz trying to contact Australian stations. In the Australian six metre band 52MHz — 54MHz, Chinese AM stations may be heard usually between 53MHz and 53.4MHz. Some evenings jamming stations can be heard.

"Needless to say the three local active six-metre stations VK4ZRG, VK4ZGJ and VK4ZPL have each worked all JA call areas many times over. Recently the first KA station was heard and worked. John KA7AB, can only hear VK stations in the first 100KHz of the Australian band. John transmits SSB in the first 100KHz of the 50MHz band. More KA stations will be on the air shortly.

"Russian TV pictures have been received in Townsville during April, similarly, TVQ channel 0 pictures have been received in Japan."

Michael Richardson, VK8ZMR, from Darwin, Northern Territory writes:—

". . . a note to provide some detailed information regarding the tremendous VK8 DX success to the north. Doug McArthur, VK8KK, Alice Springs has been working openings to Japan since middle to late February 1967.

"Barry Burns, VK8DI, Darwin has worked about 90 JA and JH stations which has included all JA call areas and JH1. On April 1, he worked KR6TAB."

Referring to his own achievements, Michael wrote: "Worked first breakthrough

JOHN MOYLE MEMORIAL — RESULTS

The results of the 1967 John Moyle Memorial National Field Day Contest held over the weekend February 11th-12th shows that the contest still retains its popularity and although the entry list was small the activity among the field stations was commendable. The multi-operator stations, having a large number of operators and ability to operate on many bands, provided some high scores.

Results:

SIX HOUR DIVISION

Section (a) Portable/Mobile Transmitting Phone

Call Sign	Score	Contacts
VK1AS/P	398	53
VK2AWW/P	518	79
VK2RJ/P	109	11
VK3LC/P	186	24
VK3JO/P	101	11
VK5MZ/P	89	11

Section (b) Portable/Mobile Transmitting C.W.

Call Sign	Score	Contacts
VK2YB/P	133	22
VK2AGI/P	104	15
VK2JM/P	97	17

Section (c) Portable/Mobile Transmitting Open

VK3HE/P	155	23
VK4UU/P	19	4

Section (d) Portable/Mobile Transmitting Multiple Operator.

Call Sign	Score	Contacts
VK3YS/P	507	79
VK4PJ/P	369	53
VK5LZ/P	608	71

Section (e) Fixed Transmitting station working Portable/Mobile stations—Open only.

Call Sign	Score	Contacts
VK3QV	200	16
VK3EZ	140	11
VK5RI	115	8
VK7SM	435	29

Section (f) Reception of Portable/Mobile Stations

S.W.L. No.	Score	Stations Heard
WIA-L4144	390	26
WIA-L4205	280	19
WIA-L4182	165	11

24 HOUR DIVISION

Section (a) Portable/Mobile Transmitting Phone

Call Sign	Score	Contacts
VK1VP/P	90	8
VK3WK/P	752	112

Section (b) Portable/Mobile Transmitting C.W.

Nil Entries.

Section (c) Portable/Mobile Transmitting Open

Call Sign	Score	Contacts
VK5ZF/P	561	64

Section (d) Portable/Mobile Multi-operator Open only

Call Sign	Score	Contacts
VK2AAH/P	3786	682
VK3RN/P	2621	467
VK3VK/P	1432	247
VK3ANU/P	1265	222
VK5LZ/P	2094	286
VK6VF/P	230	30
VK9XI/P	1019	175

Section (e) Fixed Transmitting Stations working Portable/Mobile Sations, Open only.

Call Sign	Score	Contacts
VK1DA	215	14
VK2AEC	300	22
VK3XB	665	53
VK3ANG	475	41
VK3KS	245	20
VK3GK	103	13

Section (f) Reception of Portable/Mobile Stations.

S.W.L. No.	Score	Stations Heard
WIA-L2022	450	36
WIA-L2023	230	19
P. Forbes	770	59
WIA-L3042	555	45
J. Ross	645	47
WIA-L5065	435	31

for Darwin on March 4, 1967. Since then have worked over 130 different JA and JH call signs and logged over 170 JA and JH QSO's on six metres.

"Also worked KR6TAB, Al Edwards on Okinawa, the first contact being on May 13, and since then have had another three contacts. JH2HMO, who at the time was running a power input of 2 watts to the final was also contacted. Also conditions have been recorded when JA stations running a power input of 20 watts have been maximum signal strength."

Like VK8DI, Michael has worked all Japanese call areas and JH1 on the six metre band.

Youth Radio Scheme

A meeting of Youth Radio Scheme personnel was scheduled to be held in Sydney on Saturday, June 3. Matters relating to administration, age limits, registration and expansion of the scheme were included on the agenda. Interstate representatives were also expected to be in attendance. A report will be given in the next issue of these notes.

The magazine committees of the Victorian Division of the Y.R.S. and the Short Wave Listeners group have joined together to produce a composite magazine called "Zero-Beat." Copies of the magazine will be sent to all members every two months. The magazine will contain news of Y.R.S. and S.W.L. activities as well as circuits and description of equipment of interest to both groups.

The official club station of the Victorian Division Youth Radio Scheme, VK3ANE, transmits a morse practice session every Wednesday evening, commencing at 7 p.m. in the 3.5MHz band for a period of twenty minutes.

This service is designed to assist students to achieve the speed necessary for them to qualify for the Junior Radio Certificate and higher.

The station operator is Don Reid, VK3EI, who is pleased to receive reports from club stations and listeners.

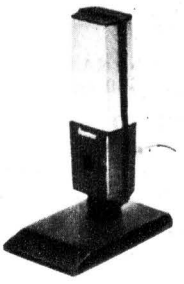
CANBERRA YOUTH RADIO CLUB

Meetings of the club are held in the Tearoom, 8th Floor, M.L.C. Building, Civic, every Saturday night from 6.30 p.m. to 8.30 p.m. The meetings are divided into sessions, the first is the elementary class followed by the junior class. Further details of the club may be obtained by either attending a meeting or writing to — Roger Davis, VK1RD, 14 Hovea Street, O'Connor.

Copies of the "Postal Group Bulletin" which contains useful technical information for Y.R.S. club leaders and members is available from Roger Davis VK1RD. Applications for the bulletin should be accompanied by a self-addressed stamped envelope together with eight cents to cover publication costs.

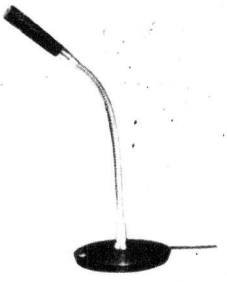
foster®

■ dynamic microphones



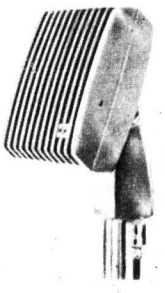
*MDF-600B
cardioid microphone

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −52 dB±3 dB,
Dimensions : 148×48×34.5 mm without stand
Cable : 4 ϕmm, 3 m
Weight : 1¼ lbs (525 g)



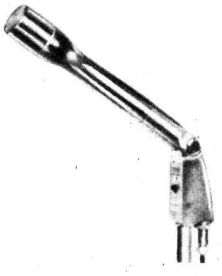
DF-1DE

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 385.5 mm high
21 mm diameter, microphone
128 mm diameter, stand
Cable : 4 ϕmm, 1.5 m
Weight : 1⅝ lbs (840 g) with cable



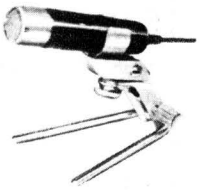
*DF-14B

SPECIFICATIONS
Impedance : 50 kΩ Variable
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −48 dB±3 dB,
Dimensions : 136×75×47 mm
Cable : 6 ϕmm, 4 m
Weight : 2 lbs (900 g)



*DF-22B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 32.5 mm diameter, 220 mm long
Cable : 6 ϕmm, 4 m
Weight : 1¼ lbs (575 g)

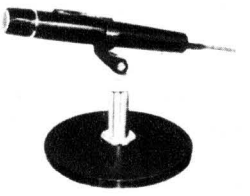


DF-1/*DF-1B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 21 mm diameter, 82.7 mm long
Cable : 3 ϕmm, 1.5 m
Weight : 3.9 oz (110 g) with cable

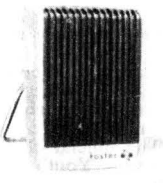
DF-3

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±8 dB
†Sensitivity : −56 dB±3 dB,
Dimensions : 33.5 mm diameter, 133 mm long
Cable : 4 ϕmm, 1.5 m
Weight : 9.0 oz (255 g) with cable



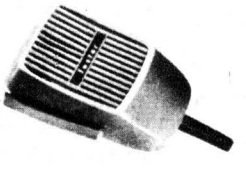
DF-12/*DF-12B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 80~12,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 23 mm diameter, 158 mm long
Cable : 3 ϕmm, 1.5 m
Weight : 6.3 oz (180 g) with cable



*DF-2B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±10 dB
†Sensitivity : −56 dB±3 dB,
Dimensions : 75×53×30 mm
Cable : 3 ϕmm, 1.5 m
Weight : 4.8 oz (136 g) with cable



*DF-51B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~8,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 98×58×36 mm
Cable : 6 ϕmm, 1.6 m, Coiled
Weight : 7.3 oz (207 g) with cable

* with switch : † at 1,000 c/s, 0 dB=1 V/μ bar

1967 W.I.A. REMEMBRANCE DAY CONTEST

The 1967 Remembrance Day Contest will be conducted under the new set of rules proposed by Bill Mitchell VK3UM, and adopted by the Federal Council of the Institute at the 1966 Federal Convention held in Brisbane. The period between the ratification of the decision of Federal Council by divisions of the institute and the date set down for the contest did not allow the Federal Contest Comittee time to publish the new rules applying, in accordance with Institute policy relating to such contests.

Two major changes in the contest relate to:

(a) the formula used to determine the score of each division;
(b) intrastate scoring for all bands above 52MHz thus allowing the scores of limited licensees to be included in the total points of a division.

The contest is held in memory of Australian amateurs who paid the supreme sacrifice during World War II. A perpetual trophy is awarded annually for competition between the six divisions of the Institute. It is inscribed with the names of those members and so perpetuates their memory throughout amateur radio in Australia. The name of the winning division each year is also inscribed on the trophy and in addition, the winning division will receive a suitably inscribed certificate.

OBJECTS: Amateurs in each Call Area, including Australian Mandated Territories and Australian Antarctica will endeavour to contact amateurs in other call areas on all bands. Amateurs may endeavour to contact any other amateur on the authorised bands above 52MHz (ie., intrastate contacts will be permitted in the VHF/UHF bands for scoring purposes).

CONTEST DATE: 0800 hours GMT Saturday, August 12, 1967 to 0759 hours GMT Sunday, August 13, 1967.

All amateur stations are requested to observe 15 minutes' silence before the commencement of the contest on Saturday afternoon. An appropriate broadcast will be relayed from all divisional stations during this period.

RULES:

1. There shall be four sections to the contest:
   (a) Transmitting Phone.
   (b) Transmitting CW.
   (c) Transmitting open.
   (d) Receiving open.

2. All Australian amateurs may enter the contest whether their stations are fixed, portable or mobile. Members and non-members of the Wireless Institute of Australia will be eligible for awards.

3. All authorised amateur bands may be used and cross-mode operation is permitted. Cross-band operation in not permitted.

4. Amateurs may operate on both Phone and CW during the contest, i.e., phone to phone, CW to CW, or phone to CW. However only one entry may be submitted for sections (a) to (c) in rule 1.

An open log will be one in which points are claimed for both phone and CW transmissions. Refer to rule 11 concerning log entries.

5. For scoring only one contact per station per band is allowed. However, a second scoring contact can be made on the same band using the alternative mode. Arranged schedules for contacts on the other bands are prohibited.

6. Multi-operator stations are not permitted. Although log keepers are permitted, only the licensed operator is allowed to make contact under his own call sign. Should two or more wish to operate any particular station, each will be considered a contestant and must submit a separate log under his own call sign. Such contestants shall be referred to as "substitute operators," for the purpose of these rules and their operating procedure must be as follows:

Phone: Substitute operators will call "CQ RD" or "CQ Remembrance Day," followed by the call sign of the station they are operating, then the word "log" followed by their own call sign, e.g., CQ Remembrance Day from VK4BBB log VK4BAA.

CW: Substitute operators will call "CQ RD de" followed by the group call sign comprising the call sign of the station they are operating, an oblique stroke and their own call sign, e.g., "CQ RD de VK4BBB/VK4BAA."

Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

7. Entrants must operate within the terms of their licences.

8. CYPHERS: Before points may be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (telephony) or RST (CW) reports plus three figures, that will increase in value by one for each successive contact.

If a contestant reaches 999 he will start again with 001.

9. Entries must be set out as shown in the example, using only one side of the paper and wherever possible standard W.I.A. log sheets should be used. Entries must be clearly marked "Remembrance Day Contest 1967," and must be postmarked not later than **September 4, 1967.** Address entries to: Federal Contest Manager, W.I.A., G.P.O. Box N1002, Perth, Western Australia. Late entries will be disqualified.

10. (a) Interstate scoring is as per published table for all bands, 52MHz and above included.
(b) Intrastate scoring for all bands above 52MHz will be on the basis of one point per contact. Portable Operation: Long scores of operators working outside their own call areas will be credited to that call area in which operation takes place, e.g., VK5ZP/2. His score counts towards New South Wales total points score.

11. All logs shall be set out as in example shown, in addition will carry a front sheet showing the following information.

Name ..... Section .....
Address ..... Call Sign .....
Claimed Score .....
No. of Contacts .....

Declaration: I hereby certify that I have operated in accordance with the rules and spirit of the contest.

Signed .....
Date .....

All contacts made during the contest must be shown in the log submitted (see rule 4). If an invalid contact is made it must be shown but no score claimed.

Entrants in the Open Section must show CW and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant, who, during the contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegible, incomplete or incorrectly set-out logs.

13. The ruling of the Federal Contest Manager of the Wireless Institute of Australia is final and no disputes will be discussed.

AWARDS: Certificates will be awarded to the three top scoring stations in each of sections (a) to (c) of rule 1 above, in each call area, and will include top scorer in each section of each call area, operating exclusively on 52MHz and above. VK1, VK8, VK9 and VK0 will count as separate areas for awards. There will be no outright winner for Australia. Further certificates may be awarded at the discretion of the Federal Contest Manager.

The division to which the trophy will be awarded shall be determined in the following way:

By using the equation,

$$S = \frac{P + 175(N - E)}{1000}$$

where S = States Trophy Tally Points
where P = Total score of State
where N = Total log entries received
where E = Entrants from State concerned.

VK1 scores will not be included with VK2 nor VK8 with VK5.

The trophy shall be forwarded to the winning division in its container and will be held by that division for the specified period.

RECEIVING SECTION
(Section D)

1. This section is open to all Short Wave Listeners in Australia, but no active transmitting station may enter.

2. Contest times and logging of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used is the same as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving station is located. A sample to clarify the position is shown above.

It is not sufficient to log a station calling "CQ" — the number he passes in a contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the M.F. and H.F. bands 1.8MHz to 30MHz, but on bands 52MHz and above such stations may be logged, once only per band, for one point. VK1/VK2 and VK5/VK8 are considered to be the same area for scoring purposes.

4. A station heard may be logged once on phone and once on CW for each band.

5. Club receiving stations may enter for the Receiving Section of the contest, but will not be eligible for the single operator award. However, if sufficient entries are received a special award may be given to the top receiving station in Australia. All operators must sign the declaration

AWARDS: Certificates will be awarded to the highest scorers in each call area. Further certificates may be awarded at the discretion of the Federal Contest Manager.

SCORING TABLE

To	VKO	VK1-2	VK3	VK4	VK5-8	VK6	VK7	VK9
From VKO	-	6	6	6	6	6	6	6
" VK1-2	6	-	1	2	3	5	4	6
" VK3	6	1	-	3	2	5	4	6
" VK4	6	1	2	-	3	6	5	4
" VK5-8	6	2	1	3	-	5	4	6
" VK6	6	1	2	4	3	-	5	6
" VK7	6	2	1	4	3	5	-	6
" VK9	6	1	2	3	4	5	6	-

NOTE: Read table from left to right for points for the various call areas.

EXAMPLE OF TRANSMITTING LOG

DATE/TIME G.M.T.	BAND	EMISSION AND POWER	CALL SIGN WORKED	RST No. SENT	RST. No. REC'D.	POINTS CLAIMED

EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

DATE/TIME G.M.T.	BAND	EMISSION	CALL SIGN HEARD	RST No. SENT	STATION CALL	POINTS CLAIMED
Aug. 1967						
12 0810	7MHz	A3(a)	VK5PS	58002	VK6RU	2
12 0812	7MHz	A3(a)	VK6RU	59007	VK7EJ	5
12 1035	52MHz	A3	VK4ZAZ	56010	VK5ZDR	3
12 1040	52MHz	A3	VK3ALZ	59025	VK3QV	1

New Electrolytic Condensers

These condensers are miniature pigtail type insulated new stock in packets of 12, each packet containing; 3, 16mfd 300V.W., 2-32 mfd. 300V.W., 1 25mfd. 450 V.W. and 6 low voltage electrolytics. **$2.50.**

Post and packing 20c extra.

NEW IMPORTED 4" P.M. SPEAKERS

Available with a 4 or 16 ohm voice coil. **$2.50.**
Post and packing 30c extra.

NEW IMPORTED SLOT CAR KITS AT LESS THAN HALF PRICE

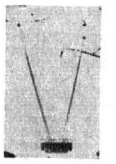
Complete kit of parts including 12V motor and full instructions.

$2.50 post 25c

Imported National Transistorised Shoulder Megaphone

These shoulder megaphones manufactured by National Radio Japan have an output of 4 watts, and are supplied complete with inbuilt horn type speaker, batteries and microphone. List price $78.

Special Price $50. Post extra
Other types also available.



NEW AMERICAN TWIN TELESCOPE TV AERIAL

Extends to 36in, each section can be used singly for car or portable .. **$1.50.** Post 20c.

SINGLE TELESCOPIC

Aerial 12in extends to 33in. 60 cents. Post 10 cents.

NEW 4-SPEED STEREO PLAYER F.O.R. .. $17.50 (£8/15/)

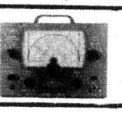
NEW STEREO CHANGER. 4-SPEED F.O.R. .. $21.50 (£10/15/)

SLIDER-SWITCHES
10 pole 2-way silver plated contacts 38c

POWER TRANSFORMER

Prim. 240V Sec. 350 volts a side. 60 M.A. One 6.3V, one 5V F11.

$2.75 Post N.S.W. 60c, Interstate 80c.



LEADER SIGNAL GENERATOR LSG11

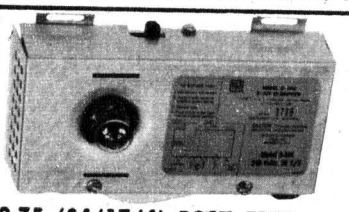
240V A.C. operated, 6 band 120KC to 390 megs. Provision for crystal.
Post N.S.W., 75c; Interstate, $1.25. **$29.50**

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt at 4 amp., $3.75. Post, N.S.W., 20c; Interstate, 20c. Transformer for above rectifier tapped for 6 to 12 volt, with circuit for charger, $4.75. Post, N.S.W., 75c; Interstate $1.00.
As above, 6 or 12 volt, at 2 amp., $2.75. Post, N.S.W., 35c; Interstate, 45c.
Transformer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.

NEW 240V. A.C. MOTORS

These small motors, size 5in x 3in x 3½in, are 1-12 h.p., but are only suitable for intermittent use. $2.95. Post N.S.W. 35c; Interstate 50c.



$9.75 (£4/17/6) POST FREE

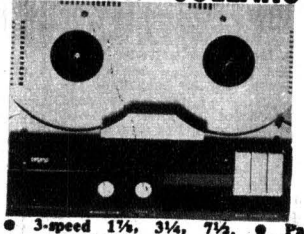
NEW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

(EX LIQUIDATION STOCK H. G. PALMER)

These TV POW-R boosters can be used in two ways. Firstly as a "straight-thru" circuit giving extra boost to the TV signal for improved performance on one receiver.
Secondly to boost signal strength to two or three TV receivers coupled to the one aerial.

Full instructions supplied with each unit. 240 volt A.C. operation.

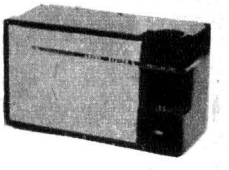
THE NEW COLLARO 3-SPEED 4 TRACK TAPE-DECKS $48.00



The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

- 3-speed 1⅞, 3¼, 7½.
- Pause control.
- Takes 7in. spools.
- Simplified controls, 4 Tracks, $48; OSC Coils, $1.50.

NEW 4" EXTENSION SPEAKERS



These 4" speakers are mounted in polished cabinets suitable for use as intercom, units or extension speakers.
LIST PRICE $12
SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $4.
Post and packing, N.S.W., 68c. Interstate, 98c.

A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October Electronics Australia complete with kit of parts including transistors mono **$7.50**, stereo **$13.00**, 240 power supply for above **$7.00.**
Please specify if required for pick-up or tape heads.

NEW 17 & 25 WATT P.A. AMPLIFIERS

25 WATT .. $53.75, £26/17/6
17 WATT .. $43.75, £21/17/6
Post Extra on 15 Watt. N.S.W., 10/; Interstate, 15/.
25 Watt by Rail or Air. Too Heavy for Post.

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms. The 25 watt amplifier can be supplied with line output transformers tapped from 100 to 600 ohms if required at $2.00 extra.

Inputs provided for microphones, pick-up, and radio with mixing facilties and tone control. The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) .. .. $6.75 .. 67/6
Crystal Microphones for amplifier .. .. $4.75 .. 47/6

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

NEW TRANSISTOR SIX PORTABLE KIT AT LESS THAN HALF PRICE

(DESIGNED TO SELL AT OVER £30/-/-)

$23.75 (£11/17/6)

Excellent fidelity is obtained in this new kit set by the use of large speaker and polished timber case with attractive gold metal front panel. By using heavy duty batteries it is economical to operate and is ideal for portable use or that second set. Complete kit of parts is supplied with full instructions. CAN BE SUPPLIED WIRED AND TESTED AT £2/10/- EXTRA. **Post and packing N.S.W., $1.25 — Interstate, $1.75.**

RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer the same at less than 25 per cent of list price.

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in ½, 1 and 2 watt ratings and include some wire wound resistors.

List price, $9.00 per 100. **Our price, $2.00 per 100.** Post and packing 25c extra.

The condensers are in most popular makes and include mica, ceramic, paper, and electrolytic in standard values.

List price, $11 per 100. **Our price, $2.06 per 100.** Post and packing, 35c extra.

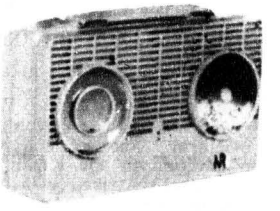
The potentiometers are all current types and include switch pots, dual concentric and T.A.B. pots.

List price, $12 per dozen. **Our price, $2.50 per dozen.** Post and packing, 25c extra.

FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Type Valve Type 6U7G, 6X5GT or 1T4.

SPECIAL — OFFER

Complete KIT for TRANSISTOR 6 PORTABLE $17.50



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Dials available for all States. Post and Pack: extra. N.S.W., $1.00, Inter., $1.30.

NEW ENGLISH MAZDA TRANSISTORS

TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	55c
XA102	OC44	Osc. Transistor	75c ea.
XB103	OC75	AUDIO general purpose	75c

Ducon type SFT 123 equiv, OC74 ..... 75c ea.
Available in matched pairs at ..... $1.50 pair

AUDIO OUTPUT

Post and packing on transistors 15c any quantity.

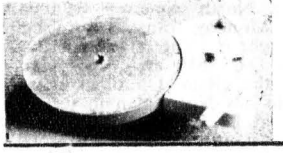
A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturer's stock E.H.T. units $5.00. Deflection yokes $5.00. Post free

NEW VALVES AT BARGAIN PRICES

807	$1.75	3Q4	75c	6H6G	35c	6SJ7	95s	12AT7	$1.00
1A7GT	95c	3S4	$1.00	6K7G	45c	6SN7GT	95c	1L5G	95c
1C7G	30c	5V4G	$1.00	6K8G	68c	6SS7 equiv. 6SK7	85c	12A6	50c
1D8GT	95c	6B8	$1.00	6Q7G equiv. 6B6G	$1.00	6U7G	45c	12SK7	50c
1K8G	40c	6C8G	80c	6SA7GT	95c	6X5GT	75c	12SK8	50c
1K7G	49c	VR99A equiv. 6J8G	$1.50	6SH7	85c	7C7	35c	12SH7	50c
1M8G	40c							866	1.50
1P8G	25c							954	25c
1Q8G	25c							955	25c
1T4	45c							EK32	68c

Please add postage on all valves.

NEW 4-SPEED STEREO & MONO PLAYERS AT LESS THAN HALF PRICE



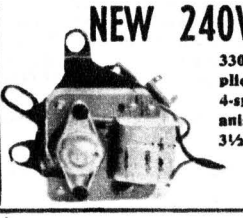
PHILIPS 4-SPEED 6V BATTERY PLAYER

MONO $9.75

STEREO $11.75

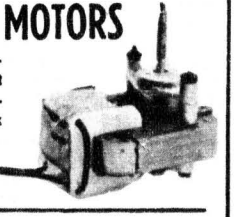
Post and Packing, N.S.W., 75c.
Post and Packing, Inter., $1.25 Extra.

NEW 240V. ELECTRIC MOTORS



3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

$2.75

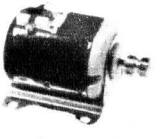


NEW PORTABLE RECORD PLAYER CASES TO SUIT THE ABOVE TURNTABLE

Attractive two-tone cabinet with plastic trim. Supplied with 5in x 7in speaker in felt-lined enclosure Space for amplifier and batteries or power supply.

$11.50

Dimensions: 15in x 13in x 7in.
Post and Packing: N.S.W., 90c; Interstate, $1.20.



NEW MINIATURE MOTORS

Ideal for models, toys, etc. 1½ to 3 volts. 6,000 r.p.m. 39c each or $3.50 per doz. Post 10c.

EXTENSION SPEAKERS

$8.50 New 9 x 6 speakers in case. Post: Interstate, 55c; N.S.W. 40c.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, **$3.00.** Plus Postage: N.S.W., 35c; Interstate, 52c.

Prim.: 240v, Sec. 385 x 385 at 80mA, fil. 6.3 and 5v, **$4.50.** Post.: N.S.W., 40c; Interstate, 75c.

60mA H.T. Chokes, 75c. Post.: 20c.

T.M.K. MULTIMETERS

Before buying see our range of T.M.K. test instruments. As advertised in April issue of Electronics Australia.

TYGAN AND SARLON SPEAKER GRILLE FABRIC

List price **$8.00** per yard.
To clear at **$5.50** per yard.
Postage and packing N.S.W., 3/6. Interstate, 4/6.

NEW MIDGET POWER TRANS.

40mA prim., 240v. Sec 225 x 225 with 6.3v. Fil. Winding.

$3.25 Postage: N.S.W., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

$3.25 Postage: N.S.W., 25c. Interstate 35c.

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools. spools.

2 Track, $35, 4 Track, $40.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Deutsche Welle Relay on El Salvador

Radio Deutsche Welle, the Voice of Germany, at Cologne, has announced plans for building of a relay base in El Salvador, to cover North and South American areas.

Some months ago, Deutsche Welle announced that they would establish relay bases in Central America and Southern Europe in addition to the Kigali relay in Rwanda, Central Africa, which began broadcasting in 1965. The new Salvador relay base will have two transmitters of 250KW and one of 150KW, while another transmitter of 100KW will carry programs on medium wave. The Kigali station with its 250KW transmitters is well received on its several frequencies in the Pacific area. The station was commenced in June, 1964, at Kigali and 18 months later it began relays of the Cologne programs for reception in Africa.

The Voice of Germany, Deutsche Welle, has been in operation more than 10 years. It has become firmly established with short wave listeners, and signals are beamed to all areas of the world. The Deutsche Welle has its studios in Cologne, and the transmitters are at Julich, about 38 miles from Cologne, near the Belgian frontier. The station has 28 masts (the tallest of them rising to about 300 feet) to carry the transmitter aerials for all the short wave frequency bands. Beams can be switched in opposite directions by push-button controls. Six 100KW transmitters feed the aerial system. Emergency transmitters of 20KW are also provided at the site. At present the Deutsche Welle is broadcasting in 14 languages, in 27 programs. The address of the station is Deutsche Welle, P.O. Box 344, Cologne, Federal Republic of Germany.

WORLD RADIO CLUB

This month the B.B.C. commences its new program for the short wave listener, World Radio Club. The session replaced Short Wave Listeners' Corner, which was on the air for some years, but was cancelled last year. The new session, whose title is taken from the World Service on which it is now carried, is to be non-technical and will cover items that interest the short wave listener and radio amateur. Special reference to B.B.C. expansion plans and broadcasting techniques which the B.B.C. has adapted for their use will be featured.

Henry Hatch, of the B.B.C. Engineering Division at Bush House, London, who was a frequent contributor to the old program, has been asked to put some of his ideas into the new series. These should assist listeners to the B.B.C. to learn more about broadcasting, and also help them to improve their reception of short wave transmissions.

DX JUKE BOX

Radio Nederland's DX Juke Box program now has four contributors each month, each of whom gives DX information from his particular part of the world. The program is broadcast at 0745 GMT on Thursday on 11730, 9715 and 9525KHz, and is repeated in all English transmissions for that day. It is also carried from Bonaire. The first Thursday is Arthur Cushen's Pacific DX Report from New Zealand; on the second Thursday it is Marc Olander's Scandinavian DX report; the third Thursday is the occasion for Glen Houser's North American DX Report, and on the fourth Thursday Marten van Delft gives his Benelux DX report. When a fifth Thursday occurs in the month, a report on the progress of the European DX Council is given in the session.

Additionally the predictions for short wave reception for the month are given on the first Thursday, and in each weekly program listeners' letters on technical questions are answered. The program is also interspersed with popular music and, at present, the lessons in the current propagation course are given one week, and the same lesson repeated the following week.

JAMMING INCREASES FROM EUROPE

Earlier this year the U.S.S.R. resumed jamming of Radio Peking programs in Russian. These transmissions were first jammed in early August, 1963, until the end of October the same year. In that month, the Soviet Union also started to jam Radio Tirana broadcasts in Russian and Bulgarian. The jamming of Radio Peking transmissions was discontinued after three months, but Radio Tirana is still being jammed as we go to press. The U.S.S.R. is no longer using the traditional type of jamming. The earlier jamming periods were characterised by taped callsigns in morse code. The new jammers do not rely on callsigns and the jamming noise consists of extremely over-modulated distorted transmissions of ordinary broadcasts, reports the Swiss DX Session.

LLH OSLO USES 9645KHz

A new frequency for Radio Norway, 9645KHz with the callsign LLH, is being used to serve North America 0400-0430-GMT. In the Monday transmission English is used throughout. The station's closing announcement lists 9610 and 11850KHz as also being in the chain. On other days of the week, Oslo has Norwegian in its transmissions, and at 0425GMT there is a five-minute broadcast in Spanish. The English transmission "Norway This Week" is carried on all the Sunday transmissions from Oslo, with the session to New Zealand and Australia taking the air 0800-0830GMT using 11850, 15175 and 17825KHz.

CAMBODIA USING 4935KHz

The transmissions of the Voice of Cambodia, in the 60-metre band, have been observed on several channels, in an attempt by the station to find a good clear signal. The station is now observed on 4935KHz, with 15-minute sessions in French at 1230 and English 1245GMT, and resumed its normal local programs at 1300GMT. The stations has sessions in English 2345GMT (Sunday 0045), 0545 and 1245GMT. A further session 0145-0415GMT, on 9695-KHz, is a relay of the home service. A further transmission is scheduled 1200-1440GMT while news is at 0200 and 0345-GMT. Medium-wave signals from Phnom Penh are also noted on 1425KHz with the news in English at 1245GMT. The station is notorious for not replying to listeners' requests for verification, and is one of the few countries which we hear regularly but have been unable to confirm.

WWV USING GMT

The National Bureau of Standards' stations WWV (formerly of Washington, D.C., and now of Fort Collins, Colorado) and

GOOD SIGNALS FROM LATIN AMERICA

This winter season has again been noted for some excellent signals from Central and South America, both in the afternoon and late evening listening period. A survey of some of the most interesting signals, compiled from the "New Zealand DX Times" and our own observations, follows,:—

KHz	Callsign	
4925	HCRQ1	Radio Quito. Ecuador has been heard opening at 1100GMT.
4935	OAX9E	Radio Tropical, Tarapopo, Peru, opens at 1055GMT, sign on with anthem and identification announcement, also 9710 KHz.
5045	CP38	Radio Altiplano, La Paz, Bolivia, operates all night and heard 0730.
5050	YVKD	Radio Cultura, Caracas, sign on now at 1000GMT.
5060	HCRP1	Radio Catolica, Quito opens 1100GMT with prayers in Spanish.,
5975	CP44	Cochabamba, Bolivia has been heard 0930-1000 after Montreal closes.
6105	HJVN	Radio Vision Medellin, Colombia heard from 1030GMT.
6120	XETS	Tapavhula, Mexico, has been heard with announcement and music after.

its sister station WWVH in Hawaii have now reverted to the use of GMT for all time announcements. The WWV announcements recently have been in Mountain Standard Time and WWVH used Hawaiian Standard Time for many years. The use of GMT will be welcomed by listeners. The signals of both stations are well received on 2500, 5000, 1000 and 15000KHz. The station has speech announcements of the time in GMT each five minutes, and has second pulses as well. Details in CW are given on ionosphere conditions and reception conditions generally. WWV signals are among the most accurate in the world—better than 1 part in 10^{10}—and can be used as marker points for receiver calibration.

B.B.C. CENTRAL AFRICAN RELAY

The B.B.C. has been operating a Central African relay station at Francistown near the Rhodesian border for some months. The present transmissions on the station, on both medium and short-wave, are as follows: 0400-0600 on 4845KHz; 0600-0830 on 7295; 1530-2045 on 4845. The medium-wave relays 602 and 926KHz carry the above schedule and additionally the World Service 0545-0600. The station carries locally originated programs at 0430-0445 on Saturdays, on 602, 926 and 4845KHz.

CLANDESTINE STATIONS

The long established "Radio Espana Independencia," which has operated from many years from Eastern Europe with programs beamed at Spain, has at last been verified. The station has the mailing address of P.O.B. 359 Prague, Czechoslovakia. The station is on the air 0600-0630GMT on 10110, 11260, 12140KHz, and 1530-2330-GMT on 6950, 7600, 10110KHz.

Radio Euzkadi, La Voz de la Resistencia Vasca (postal address P.O. Box 59, Paris 16, France), broadcasts in Spanish and Basque daily 2030-2100, 2130-2200 and 2230-2300 on 15080, 13250KHz. The station confirms reception reports by letter in English, and identifies in Spanish, Basque and English.

A new station is planned on Navassa Island, between Haiti and Cuba. The island is owned by the United States. The transmitters will be 50KW MW and 20KW SW, and will operate on the lines of Radio America, with Spanish programs.

FLASHES FROM EVERYWHERE

MALAYSIA: Kuala Lumpur has been observed on 5965KHz at 2255 to 0015GMT. The station has commercial programs, and news in English at 2330GMT. The reception of Kuala Lumpur has been reported in South Africa. The station now verifies with a new card showing a map of Malaysia with a flag on the left hand corner, and with a short history of Malaysia and verification details on the reverse side.

NIGERIA: Lagos, with the broadcasts of the Voice of Nigeria, has sessions in French at 1300-1400, 1900-2100GMT; in Hausa 1400-1500; English 1500-1600, 1700-1900 and 2100-2200; and Arabic 1600-1700. All these transmissions are on 7275, 9690, 11900KHz.

VIETNAM NORTH: Radio Hanoi is on air daily in English at 1000-1030, on 7210 9760KHz; 1300-1330, 1530-1600 on 1240, 7210, 9640, 11840; and at 230-2330 on 1240, 9840, 11840KHz.

INDONESIA: Djakarta, in its program "Voice of Indonesia," is well received on 9865KHz with programs in English for Britain and New Zealand 1900-2000GMT. The mailing address of the station is P.O. Box 157, Djakarta.

GERMANY: Radio Free Europe now broadcasts from Germany, and its extensive new schedule gives some of the most interesting reception. We have heard the 3960KHz channel in Polish 0355-0550-GMT and 2110-2310GMT. They use 3970KHz in Hungarian 0355-0530 and

STATION SCHEDULE CHANGES

RADIO PRAGUE ENGLISH SCHEDULE

Radio Prague's English language transmissions has now put into operation four frequencies in the 13 metre band, in its overseas service of English transmissions schedule, which is valid to October 22 in broadcasts from Czechoslovakia.

GMT	AREA	KHz
1200-1230	Europe	9560, 11960, 15285
1900-1930		5930. 7345.
1530-1630	Africa	6055, 11990, 15285, 17840, 21735.
1730-1830		5930, 7345, 11990, 17840, 21620.
1400-1500 (Sunday)	North America	15448, 17705, 21450.
0100-0200		7345, 11990, 15368, 17840.
0330-0430		5930, 7345, 11990, 15368.
0700 0800	N.Z., Australia	6055, 9550, 15310, 21450, 21700.

RADIO NEW ZEALAND SCHEDULE

A new schedule now in operation by Radio New Zealand, Wellington, includes the use of a new frequency 17770KHz in its Australian beam.

GMT	AREA	KHz
1700-1945	Pacific	ZL18 9520, ZL3 11780.
2000-0545		ZL21 15110.
0600-0845		ZL18 9520, ZL3 11780.
2000-2230	Australia	ZL3 11780.
2245-0545		ZL5 17770.
0900-1145		ZL18 9520, ZL3 11780.
0215-0245	Antartic (Sun. only)	ZL3 11780.
0815-0845		ZL7 6080.

During the service to Antarctic, 17770 is withdrawn 0200-0300, and 11780 at 0800-0900GMT.

The program up to 0545GMT is relayed from the NZBC Home Service, and from 0600GMT the transmisison is the special Radio New Zealand service to the Pacific and Australia.

The monthly DX Session, "Arthur Cushen's DX World" is carried on the first Wednesday at 0645 and 1030GMT on 9520, 11780, and the following Saturday at 2345GMT on 15110 and 17770KHz.

ENGLISH FROM RADIO NORWAY

Radio Norway at Oslo on Sunday each week has a 30-minute program in English called "Norway this Week," which is heard in transmissions directed to a world-wide audience. The present schedule is:

GMT	AREA	KHz
0800	Pacific, Far East, Africa.	11850, 15175, 17775, 21655*, 21730*
1200	North Europe, Pacific, Far East.	7240. 15175. 17825, 21655*, 21730*
1400	America, Indonesia, Australia.	15345, 17825, 21655*, 21730, 21670*
1600	America, Middle East, S. Africa.	15345, 17825, 21655*, 21670*, 21730
1800	America, Africa.	11850, 17825, 21655*, 21670*, 21730
2000	America and East Africa.	15345, 17825, 21730, 21655*
2200	West Europe, South America.	15345, 17825, 21730, 21655*
0000	(Monday) America.	11735, 15175, 15345, 21655*
0400	North and Central America.	9645, 11735, 11850.

Power is 120KW except when indicated with * when it is 10KW.

CHANGES FROM BERNE

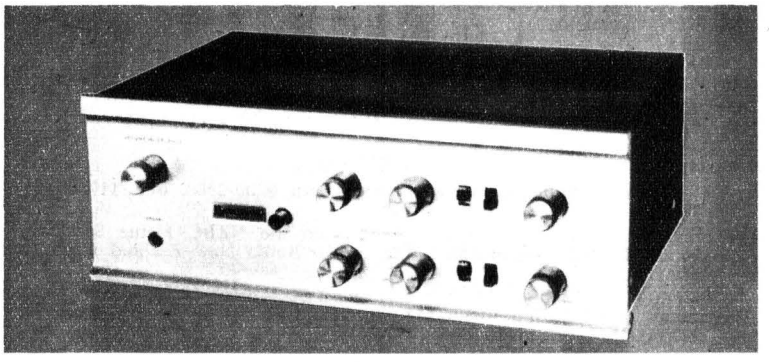
The Swiss Broadcasting Corporation has altered its schedule to make each transmission of 75 minutes duration. Also, they commence 15 minutes later than formerly.

GMT	AREA	KHz
	ENGLISH	
0130-0245	North America (East)	6210, 9535, 11715
0515-0630	North America (West)	9695, 11715
0715-0830	Australia, New Zealand	9590, 11715, 17890
0915-1030	Africa	15305, 17830, 21520
1115-1230	U.K. and Ireland	9665, 11865
1315-1430	Japan, S.E. Asia	16135, 17775, 21525
1515-1630	Middle East	15305, 17830, 21540
1900-2045	U.K. and Ireland	9665, 11865
	SPANISH	
0015-0115	South America	9535, 11775, 15305, 17830
0330-0430	Central America	9535, 9695, 11715,
1400-1500	Spain	9665, 11865
2130-2230	Spain	9665, 11865
	PORTUGUESE	
1030-1100	Africa	15305, 17830, 21520
2100-2130	Portugal	9665, 11865
2315-2345	Brazil	9535, 11775, 15305, 17830
	FRENCH	
1815-1845	Africa	15160, 17845
	ARABIC	
1700-1730	North Africa	15305, 17830, 21540
1745-1815	Africa	15160, 17845

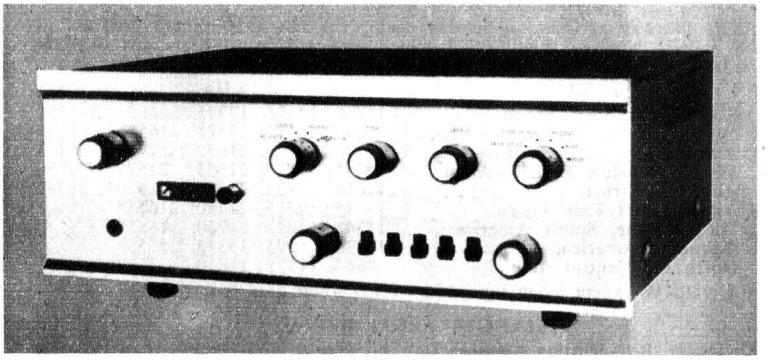
LUX SETS NEW PERFORMANCE STANDARDS

New vistas in electronics have been opened by the research division of the Lux Corporation, Japan's leading manufacturer of high quality amplifiers and associated equipment. Engineering and wiring are most meticulous as detailed examination discloses. The NHK Broadcasting Network use Lux amplifiers—and the Olympic Stadium in Tokyo was equipped with Lux public address systems. Much Lux electronic circuitry carries world wide patents and is exclusive to Lux amplifiers. As Australian agents, Encel Electronics Pty. Ltd. has selected a number of Lux models; in every case the unit offers remarkable value and is fully guaranteed.

THE LUX SQ-101 SOLID STATE STEREO AMPLIFIER—

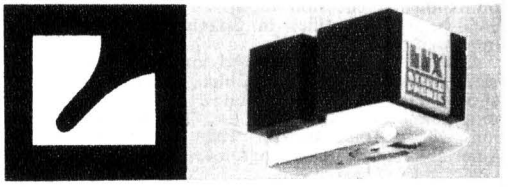


This fine silicon transistor stereo amplifier is rated at 80 watts peak power output and distortion is negligible at normal lounge room listening levels. Frequency response is 15-50,000 Hz. plus or minus 2 dB. Magnetic sensitivity is 3.5 mV, tape head input 1.8 mV and additional features include unique bass and treble control circuitry permitting changeable crossover frequencies for both high and low ranges. High cut (scratch filter), low boost (loudness control), tape monitor, speaker switch, headphone jack and normal treble/bass controls are standard. Used with 16 ohm speaker systems power output is 15 watts R.M.S. per channel. The audio excellence of the SQ-101 is obvious even to the untrained ear. Earlier substantial shipments sold out in a few days! **$189**



THE LUX SQ 65—30 WATTS R.M.S. PER CHANNEL

With a wide frequency response of 20-20,000 Hz. plus or minus 1½ dB. at full output, the circuitry of the SQ 65 incorporates silicon diodes and P.P. 7868's, output being 30 watts R.M.S. in each channel. Input sensitivity is 4 mV. for magnetic p.u. Tone compensation circuits include a U.S. patented M.F.B. system and new Lux NF electronics. Substantial grain oriented output transformers of unique design are responsible for the outstanding performance of the SQ 65. Features include tape monitoring circuit, phase switch, blend control, speaker switch, headphone jack, scratch filter and rumble filter. The MFB circuitry is effective on normal speaker systems. Write for complete specifications **$199**



NEW MOVING MAGNET STEREO CARTRIDGE

The Lux T-15-M has been acclaimed as a brilliant performer by discriminating audio enthusiasts—frequency response is conservatively quoted at 20-20,000 Hz. and stylus pressure is from 1 to 2½ grams. Tracking angle is 15°, output is 5 mV. at 1 kHz. Stylus sizes available are 0.7 and 0.5 mil. conical diamonds. From a musical appreciation point of view the Lux T-15-M compares favourably with cartridges twice the Encel price. **$24.50**

NEW LUX AMPLIFIER SOON TO BE RELEASED

An all new model, the SQ 1220, will soon be available. This solid state stereo unit is rated at 56 watts R.M.S. into a 16 ohm load in each channel. Production of this superlative amplifier will be restricted so enquire now! Full specifications on request. Price is expected to be very close to $300.

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2000-2300GMT, while 3995KHz is used in Czech 0357-0600 and 2130-2300GMT. On the 13M band, Radio Free Europe is scheduled on 21575 in Roumanian at 0622-0800; 21600 in Hungarian at 0800-1810; 21665 in Czech at 0815-1500; 21665 in Roumanian at 1500-1900; 21680 in Bulgarian at 1600-1815; 21720 in Czech at 0800-1900; 21745KHz in Polish at 0810-1845GMT.

SWAN ISLAND: The station operating from this island in the Caribbean has dropped the use of its short wave frequency of 6000KHz and now uses medium wave only, 1160KHz, with the power of 50KW. The programs are all in Spanish from 1000-1330 and 2200-0200GMT. The station has the mailing address of P.O. Box 352, Miami, 1, Florida.

MEXICO: Station XEO1 is reported to be heard by Bob Padula of Melbourne with its slogan, "Radio Mil," on 6010KHz, to close at 0800GMT. Other reports mention the heavy sideband interference from Radio Havana, Cuba, using 6015KHz, which we also experience. XEFT, using 9540KHz, and listed with 250W, has been heard at 0500 at times, but also has severe sideband trouble. Verification from this station has been received in 14 days by a North American listener.

MOROCCO: This country is now verifying reports with a new folding card which gives the details in English, French and Arabic. As well, the station sends a full coverage of the station's schedule on medium wave and short wave frequencies. Best reception at present is 1830 to 2300-GMT on the frequency of 11735KHz with programs beamed to Europe. The transmitter is located at Tangier and uses the power of 50W. English is heard at 2130-GMT on this channel.

PORTUGAL: Lisbon is using the frequency of 21660KHz, with programs from 1345 to 1700GMT in Portuguese, beamed to Cape Verde. Lisbon is also using 15380-KHz, 2130-0100GMT, with Portuguese beamed to Brazil, and Spanish, 0100-0145. English to the United Kingdom is 2045-2130 on 7130, 6025KHz, and to North America 0200-0245 and 0345-0430 on 9680, 6185, 6025KHz.

SWEDEN: Stockholm is now on a new schedule and the changes which have been notified are as follows: 0900-1030-GMT on 21690 (replacing 21585) to Middle East; 1730-1930GMT on 15240-KHz (17840) to Africa; 1830-1930 on 21690 (11705) to Africa; 2025-2115 on 11805 (11705) to North America, and 2245-2345 on 11810 (9620) to South America.

MOROCCO: Rabat has a service in Spanish from 2300-2355GMT. Best reception is on 15390KHz. The station is also reported to be using 7255KHz with the same program, with transmissions beamed for reception in South America.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Greenwich Mean Time, add 8 hours for Perth, 10 hours for Sydney and 12 hours for Wellington time. All frequencies in kilohertz (KHz) previously shown as kilocycles (KC).

SYRIA: Damascus is using the frequency 17860KHz in Arabic 1300-2300 for listeners in North Africa when they relay the Home Program. Between 1900-2300 they use 15165KHz for the same program; before this time, the frequency is used for its foreign language service to Europe. The 15165KHz channel has been observed with English, 1600-1700 and French, 1800-1900GMT. The service from Damascus to South America has also been observed on 17865KHz from 2300-0100GMT.

LIBERIA: Station ELWA, located at Monrovia, is heard in New Zealand at good level at 1900GMT. The program at this time is in Arabic and it continues in this language to 2000GMT, when French has been noted on the channel. The station is also observed with English at 2200GMT, but has weakened in signal level by this time.

ITALY: Vatican Radio has altered its frequency in its service to South America, which is now beamed on 17860KHz. The station opens at 2400GMT with a program in Spanish which continues to 0020GMT. The station is well received, but suffers some sideband interference from Radio Australia on 17870KHz.

LEBANON: Beirut has moved to the 16M band for its South American service, and uses the new channel of 17760KHz. The station opens at 2300GMT with 30 minutes in Portuguese, then follows an hour in Arabic and the final 30 minutes is in Spanish to sign off at 0100GMT. Beirut has also altered its transmission in some other services to higher frequencies, for our winter reception period.

ITALY: Rome, in its service in Italian for Latin America, operates 2230 to 0100-GMT. The frequency of 17770KHz is used, and this is mixed with Radio New Zealand, as well as suffering sideband interference from Hilversum on 17775-KHz, in its Dutch service to South America.

BULGARIA: Sofia used the new 16M-band channel of 17800KHz for its service to South America. The transmission in Bulgarian is on the air 2300 to 2325GMT. This is the first time we have noted Sofia in this band. Signals are at good level, but a weaker signal on the same frequency causes some slight interference to the broadcast.

SWITZERLAND: A new 16M-channel for New Zealand reception is on the air from Berne at 0715GMT on 17890KHz. Signals are mixed with a Radio Taiwan station on the same frequency, and the Berne signals are much better on 9590 and 11775KHz. The new transmission time is also carried for reception in Europe with the program broadcast on 6165 and 9535KHz. This English transmission is not in the service to Europe on Sundays.

POLAND: Transmissions from Radio Warsaw to the British Isles are now on the following schedule: 1830-1857GMT on 9525, 7125KHz; 1930-2000 on 9525, 7285, 7125; 2030-2100 on 9675, 9540; 2130-2155 on 9525, 7125; 2230-2300 on 9540, 7285KHz.

DOMINICAN REPUBLIC: Station HIMS Radio Cristal, Apartado 1322, Santo Domingo, is operating on BC 570KHz, and also has a short-wave transmission on 5010KHz. Transmitter power is 800 watts. The station operates 1100-0500-GMT, and requests reports from overseas. Return postage is not required.

FINLAND: During the present winter period the Helsinki station's daily transmission to North America will be on 1518KHz, with English at 2300 and Finnish at 2315-1400GMT.

SWEDEN: Transmissions from Stockholm have undergone some changes. Broadcasts which have been changed are: To North America (East Coast) 0000-0230 on 11805KHz; to West Coast of North America, 0300-0430GMT on 11705KHz; to South Asia 0445-0615 on 17840KHz; to Europe 0900-1215 on 9625KHz; to Far East 1100-1215 and 1230-1330 on 15240KHz; to Australia and New Zealand, 2245-2345 on 9620KHz; to South Asia, 1400-1530 on a new frequency, 21585KHz; to Africa, 1715-1930 on 17840KHz.

BULGARIA: Radio Sofia is noted on the new channel of 11955KHz, with English transmissions to Africa, 2105-2130GMT. The same program is also carried on 11970KHz, and at 1905-1930 a transmission on 15312KHz is broadcast.

MOZAMBIQUE: The program of the Radio Club of Mozambique, Lourenco Marques, is noted on 11775KHz. The program is in English from sign on at 0330GMT. The station has opening announcements in both English and Afrikaans before programs commence at 0330-GMT.

RADIO CANADA'S INTERNATIONAL SERVICE

The overseas service from Montreal, Canada includes the use of the 13 metre band for its service to Africa and Europe. The service to the South Pacific remains unchanged. The full service is:

GMT	AREA	KHz
0725-0820	Africa	9625, 5990 (B.B.C. relays 21610, 17715, 15390)
0825-0935	Aust.-New Z.	9625, 5970.
1055-1212	Europe	21460, 15365, 9625.
1215-1313	United States	15365, 11720, 9625.
1316-1342	Europe	17820, 15365, 11720.
1345-1830	Europe	21460, 17820, 15365.
1830-1958	Africa	21460, 17820, 15320.
2000-2152	Europe	21460, 17820, 15320.
2200-2250	Northern Canada	17820, 15190, 11720.
2300-0045		15190, 11945, 9625.
0100-0230	U.S.A. and S. Amer.	15190, 11720, 9625.
0230-0600	North. Canada	11720, 9625.
0600-0705	Europe	11760, 11720, 9625.

BROADCAST BAND NEWS

PHILIPPINES: Voice of America has withdrawn its transmitter at Malolos, which has operated for many years on 920KHz with 50KW. The transmitter carried the V.O.A. programs for reception in the Philippines. The external coverage from the Philippines was handled by the transmitter on 1140KHz with the power of 1000KW broadcasting 1200-1630GMT. The other megawatt transmitter of V.O.A. in the Pacific, at Okinawa, continues to operate on 1178KHz, and is on the air 1100-1600. The V.O.A. station at Saigon on 760KHz broadcasts 1100-1630 and power is presumed to be 50KW.

THAILAND: The Australian Government through SEATO has given three transmitters to Thailand to counter Peking propaganda. The transmitters, two of 50KW and one of 10KW, are already in operation. The 50KW transmitters are at Korat, 140 miles north-east of Bangkok and Khon-Kaen, 230 miles north-east of Bangkok. The 10KW unit is at Ubol.

NEW ZEALAND: Transmission hours of several N.Z.B.C. stations have already been extended. Sign on of Hamilton 1XH is now 1700GMT on weekdays. Programs of this station are relayed by 1ZO (1420), 1ZU (1520), 1ZD (1000) and 1ZC (1350). Later this year, Taupo, 1ZA 1500KHz will join the network, which specialises in early morning music and news for farmers.

The Hawkes Bay station 2ZC, which has previously operated from studios in Napier on 1280KHz has since June also had studio facilities in Hastings and will operate from this site for half of its broadcasting time on the air. The station runs a 1800-1200GMT schedule except on Saturday, when sign on is at 1900GMT.

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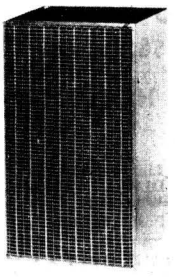
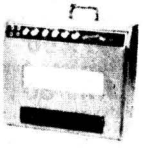
6in	8in	12in
$29.50	$33.50	$36.50





GUITAR AMPLIFIERS

10-Watt, Two Channel, with Twin Cone Speaker .. $53.55 £26/15/

14-Watt, 4 Inputs, Bass and Treble Boost, 2 Twin Cone Speakers .. $63.00 £31/10/

17-Watt, Four-Channel, Bass and Treble Boost. Two Twin Cone Speakers $76.25 £38/2/6

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin Cone Speakers $109.05 £54/10/6

Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 (£5/5/) extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato control included.

$163.50 £81/15/-

SLAP BASS OR BASS GUITAR
40 WATT AMPLIFIER

4 Input Channels. Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

$145.75 £72/17/6

PIGGY BACK GUITAR AMPLIFIER

30 Watt	$79.75
45 Watt	$99.75
60 Watt	$119.75

4 Inputs. Bass and Treble Boost. Vibrato if required, $10.50 extra.

PLAYMASTER 116
GUITAR AMPLIFIER

Kit Set	$79.95
Wired and tested	$91.95

REVERBERATION-PRE-AMPLIFIER

2-Channel input. Fully transistorised. A.C. Powered.
Plugs into and matches any Guitar, Organ or P.A. Amplifier.

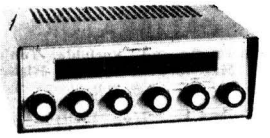
£29/17/6 $59.75

TAPE ECHO UNIT

Suits any Guitar amp. without any alteration.
JUST PLUG IN.

$139.50

PLAYMASTER 106 AND 107



Feb. and March Elect. Aust.

106

WIRED AND TESTED. **$88.75**

107

WIRED AND TESTED **$79.00**

V.T.V.M. MODEL TE-40 MILLIVOLTER

Spec. AC.V. Imv.—300 Vrms. 10 ranges. Accuracy 5 cps—1.2 mc, plus-minus 2dB, 10 cps-1 mc, plus-minus 1dB. 20 cps-250 KC., plus-minus 0.2dB.
dB. Scale: 40-30-20-10.0. 10.20, 30.40, 50 dBm. 240 V.A.C.

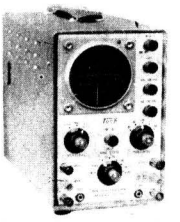
$47.50.

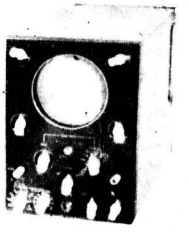
MODEL TE-65 V.T.V.M.

DC.V 0-1.5-5-15-50-150-500-1500 V. Rms. AC.V. 0-1.5-5-15-50-150-500-1500 V Rms. 0-1.4-4-14-40-140-400-1400-4000 V. P.P.
Resistance RX10.100, .1K, .10K, .100K, .1M, .10M. Decibel—10db, minus-plus 65dB.
240 V.A.C.

$42.50

TEST EQUIPMENT



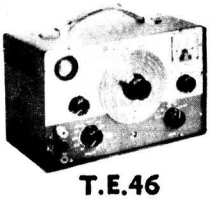


WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $99.75; 5-inch $111.50

T.O.2 TV portable service unit 2" oscilloscope $59 50.
C.R.O. DOUBLE BEAM SWITCHING UNITS
$39.75



T.E.46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20 pfd to 2,000 mfd. Resistance 2 ohm to 200 megs. Also tests power, factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.

Indications by eye and meter.

$47.75

LEADER SWEEP & MARKER GENERATOR SMG 532

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

$170.00

Post., N.S.W. $1.50; Interstate, $2.50

SIGNAL GENERATOR

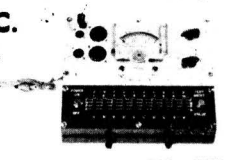
Deluxe Model TE 20D.

Freq. range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self calibration. Marker generator. Printed circuit. 240 V.A.C.

$27.50

Post., N.S.W. $75c; Interstate $1.25.

T.C. 2



VALVE TESTER

Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

$26.75

Post, N.S.W. 25c; Interstate $1.25.

T.E. 50.—99—5011
Checks, Nu Vistas, Compactrons, etc.

$34.25

G.D.O. UNITS

Leader. 810. 6-Band. 2 Meg to 260 Meg Nuvistorised, 240 V.A.C. Operation. Modulated. Calibration. Accuracy 2 per cent.

$41.50

T.E. 18 Lafayette. 8 Bands. 360 K.C. to 260 Megs. 240 V.AC. operation

$39.50

Post, N.S.W., 50c; Interstate, 75c.
T.E. 15 Transistorised. 7 Band, 360 Kc to 270 Megs.

$34.75

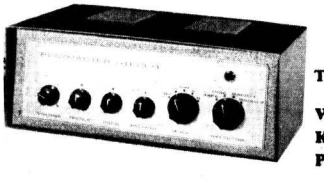
AUDIO GENERATOR

DeLuxe Model TE—22D.

Freq. range. Sine 20 cps—200 KC. SQ. 20 cps—25KC. Output voltage, Sine 7V. SQ. TV P-P. Output impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation.
1/1, 1/10, 1/100, 1/1K. Printed circuit.
240 V.A.C.

$41.50

Post. N.S.W $1.00; Interstate $1.50



PLAYMASTER 115

The new solid state Stereo-Amplifier. April Issue.

Wired and Tested	$104.00
Kit Set	$90.00
Pre-amp to suit magnetic cartridge	$12.00

ANSWERS TO CORRESPONDENTS

When writing to us:—

- *Please give you name and full postal address including the State.*
- *Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.*

APOLLO RECEIVER: Would it be possible for you to develop a receiver to cover the Unified S band used by spacecraft in the Apollo project? There are hundreds, perhaps thousands, interested in tracking satellites and space probes using these frequencies — 2100 to 2300MHz. **(P.G., Brisbane, Qld).**

As you modestly observe, this is a pretty tall order, but we wonder whether you realise just how tall it is. It is a very different proposition from the "Fremodynes" and UHF converters, to say nothing of the antenna problems involved. Right at the moment, the chances of us doing much about it are slight.

HERTZ HURTS! Leaders in intelligent thinking in the U.S. have announced quite firmly that they have no intention of changing to Hertz from cps. I have been associated with the game for a long time and while my present interests are restricted to UHF and SSB I also have an interest in young people. The change to Hertz is all part of a rebellion by the so-called intellectuals who have done damage to the fields of art, etc. Mini skirts, junk art, the breakdown in moral values are all part of it. **(W. O., Leederville, Tas.).**

Phew! Statements like those ought to qualify for some kind of a prize. We would have regarded the technical men behind the U.S. National Bureau of Standards, behind highly regarded journals and learned societies and behind electronically involved corporations as reasonably intelligent people. Nor can we see quite as intimate a connection as you between Hertz and loose morals. Presumably the rot must really have started way back when other men's names began to be allocated to electrical quantities. You're allowed not to like the term and to avoid its use; resistance to it might conceivably reverse the swing to its adoption — but we certainly don't go along with your line of reasoning.

PLAYING 78RPM RECORDS: What type of potentiometer is used in the "Basic Stereo Amplifier" for tone and volume controls? Is it all right to play mono discs with a stereo pickup? By the way, any reader interested in playing 78 rpm records should obtain the book "Mullard Circuits for Audio Amplifiers." **(P. C., Taralgan, Vic.)**

Thank you for the suggestion about the book, P.C. The potentiometers used for volume and tone controls in amplifiers are usually logarithmic. However, for a project of the "Basic" type, any available pot could be used at least for the tone conrol without serious detriment to the performance. The subject of playing mono records with stereo pickups was discussed in "Know Your Gramophone, Part 6" in our January, 1967, issue. As this article explains at some length, the results depend on the type of stylus used but, in general, there is no objection to the practice.

GAIN, IMPEDANCE, etc. What is meant by a source follower having a gain of 0.9? I also have trouble in understanding impedance matching and think that these would be suitable subjects for the "Answer Man."

I enjoy reading the magazine and am fascinated to see how it has changed. Twenty years ago it was written in a more personal, light-hearted way, although "Let's Buy An Argument" for August 1961 rates as just about the funniest article ever presented in The journal. **(F.A., Caulfield, Vic).**

Thanks for your kind comments, F.A., we certainly appreciate readers letting us know how they feel about the magazine. Quite deliberately, we have had to modify our "Let's have fun-hobby" approach, but electronics has come of age since the early days of "Radio and Hobbies." We must be somewhat more professional in our approach, to keep in line with the tone of the industry. Yes, we will certainly pass your questions to the "Answer Man," as these are problems common to many.

HEATER VOLTAGE: The heater voltage from a particular power transformer in my possession measures 7.8 volts with a load current of 0.3 amp. and the valves in the small set which it supplies have been lasting only a few months. I understand that heater voltage should be within about 10 per cent of the rated value. By the way, the cost of electronic components, with tax, is far too high. **(G. D. Glenroy, Vic.)**

It is possible that the transformer you have is a faulty one but, before criticising the manufacturer too roundly, it may be wise to consider certain relevant points. Firstly, is the heater winding, and the whole transformer for that matter, being used at somewhere near its rated load? If it is very lightly loaded, the voltage will be higher than at its proper rated current. Again, it may be necessary to consider the normal mains voltage in your area and note whether you are using the appropriate primary tapping. And what of your multimeter? It could easily be several per cent out, especially on the low AC volts range. In short, are the figures quoted to be accepted as proof of the manufacturer's negligence or are they the result of a number of small inaccuracies adding up to present an alarming result? In car radio service, valves may be called upon to operate intermittently at up to 7.5 volts or 15 volts respectively for 6 and 12-volt systems but the valves fortunately seem to cope reasonably well with the situation. Your figure of 7.8 volts is higher than this again but, even so, the rate at which you are going through valves seems rather startling. The fact that a couple of these were of indeterminate age and origin might suggest possible failure for other reasons. However, we could not support the idea of running valves unnecessarily at such a high heater voltage and if, in fact, you can verify your figures, it would seem desirable either to take the matter up with the manufacturers or to insert a series resistor in the heater circuit. Yes, the cost of components is high and nobody is more concerned about this than we are. Unfortunately, there is no easy answer to this. If the Government has to extract a certain amount of revenue to carry on, and the work force as a whole is determined to maintain a certain standard of living, the tax and labour content of components is inevitably going to be substantial. The situation is not peculiar to Australia, though it is aggravated by our relatively limited market potential.

DEAD LETTERS: A letter addressed to **Mr Trimarchi Francesco,** Hendon, S.A.— the only address given — has been returned by the postal authorities marked "not known." Will the writer please supply a more detailed address so that his letter and issue may be delivered. We are holding a letter from **Mr S. Gilchrist,** who gives his address as 68 Eldorado Street, T. Hill. Since we can find no reference to such a post-office in any Australian State we suggest Mr Gilchrist write again giving a more complete address.

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, chassis dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs for metal-working but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issue from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last twelve months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, New South Wales. Other correspondence should be directed to The Editor.

SOUND PROJECTORS

Clnevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.

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CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

12/6 $1.25 each

Post 10 cents

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder.

18/6 $1.85

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Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries in each phone. Any number can be connected together on single line.

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(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

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F.24 Mark IV 2.9 Lens, stops 11, 8, 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.

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(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite

£15 $30

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MINIATURE ELECTRIC MOTORS

1½ to 3 volts DC; ideal for model boats, cars, planes, etc. Strong torque. Only

39 cents each

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TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ¼ mile). $7.00 per coil.
Post, N.S.W. 70c; Interstate $1.20.

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P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

AWA OSCILLOSCOPE

Calibrated with delay time base. 5in, 240 vac., perfect.

£97-10-0 $195.00

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Subminiature 4-Transistor, Audio Push-Pull.

£3-10-0 $7.00 Post 50c

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NEW, IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.

12/6 $1.25

Post and packing, $1.00.

HAND BEARING COMPASS

Brand new in wooden carrying case, complete with batteries.

£17/10/- $35.00

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P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
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1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

10/- $1.00 each

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1.2 volts 15 AH, 8in x 4in x 2in. $2.95.
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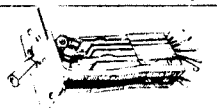
PERSPEX

Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.



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45c each. Post, 15c.

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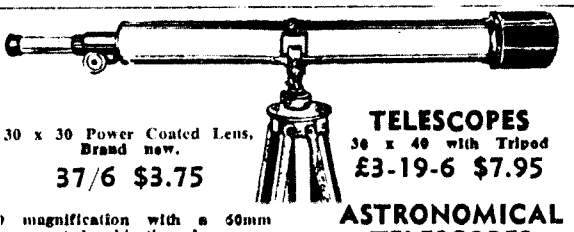
BRAND NEW

IN CARTONS.

Special discount for quantity

807	$1.75	6AG5	80c
6SN7GT	95c	12AU7	$1.00
89	$1.00	X61M	$2.20
12SA7	$1.25	CV850	$1.50
6H6	45c	1H6G	30c
41	$1.25	832	$5.00
5U4G	95c	6F13	75c
77	$1.00	6AK5	$1.50
VR150-30	$1.00	6X4	$1.00
5CPI	$3\95	6F8	75c
EF50	35c	6N7	$1.00
6U7	75c	12SK7	80c
V1103	$1.00	VR1120	80c
VH120	75c	VR118	75c
IL4	$1.00	VR65	25c
5Y3	$1.50	VT4C	75c
6C4	80c	AU3	$1.00
CV2184	$2.25	80	$1.25
2 x 2	75c	6AK5W	$1.50

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 x 30 Power Coated Lens, Brand new.

37/6 $3.75

60 magnification with a 60mm coated objective lens. With Tripod.

£11-10 $23.00

As illustrated.
Postage, 95c; Interstate $1.20.

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30 x 40 with Tripod

£3-19-6 $7.95

ASTRONOMICAL TELESCOPES

3¼" Reflector. 126 Magnification complete with 4X Finder and Equatorial Mount.

£29-10-0 $59.00

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0-115 V.A.C. 10 Amps, $29 each, or couple 2 together for 240 V.A.C.

The two for $45

Genuine American Zenith Variacs

0-115 V.A.C. 7.5 Amps, $19.50 each or couple two together for 240 V.A.C.

The two for $36.

50c cartage to rail. Freight payable at nearest attended railway station.

522 TRANSCEIVERS

100 to 150 m/cs.

£17-10-0 $35.00

KLYSTRON MIXER/DUPLEX units, 9375 megs, complete with crystals, $13, £6/10/ each. Post. N.S.W., 45c; Interstate, 50c.

FRACTIONAL 240V AC MOTOR

1/25 h.p., new, with coupled 2-speed gearbox. 1425 and 300 r.p.m. Ideal for rumbler, etc.

£10-0-0 $20.00

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Steel ex-P.M.G. Height 45in x 27in x 34in will make ideal test bench. £5 — $10.
Freight payable at nearest attended railway station.

C.M.A. CABLE

240 volt 3/.036 black, new and perfect. 100 yds. rolls, $3.00, 6 or more.

£1-5-0 $2.50

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Brand new Goodell-Pratt, 0 to 1in, $7.50; Slocombe, 1in-2in, $7.85; Starrett 1in-2in, $9.85.
Post, 32c.

CHOKES, 7.5H, 60mA 95c
VIBRATORS, 6 volts, 7-pin, 75c each.
UNISELECTORS, 4 BANK, $4.00
INVERTERS, 26v-115v 2Kw 400 cycle $9.50
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No. 19 2-way radios, with hand set, power supply, leads. $35.00
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EVERSHED and VIGNOLES, 500 volts.

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PRISMATIC. Coated Lenses. Brand new. Complete with case.

8 x 30	$18.75
7 x 50	$22.15
10 x 50	$23.07
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20 x 50	$24.75

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With solar cell can experiment with 20 different circuits, including wireless, microphone, morse code, transistor radio, audio frequency amplifier, telegraph, transmitter, intercom., signal tracer, etc. No tools, no soldering. Easy to assemble. Assembly manual included.

$19.95

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Ex A.M.F. No. 2 Mk. 3, with Instruction Book. Complete in wooden case. $39.00. Freight payable at nearest attended railway station.

4 DIGIT RELAY COUNTERS

50-volt D.C., suit slot car, Lap counters, etc.

$1.25, 12/6 each.
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SCOTCH BRAND.
EX-WOOMERA.
SLIGHTLY USED.
PERFECT ORDER.

Ideal for professional quality audio recording.

1200ft 7in reel ¼in $2.75. Post 12c.
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CRYSTAL CALIBRATOR

With 500kc crystal up to 32 m/cs, used, good condition, £4/17/6 ($9.75).

ALTEC STUDIO MICROPHONES

639B Western Electric, top grade, original cost $250, ideal Broadcast Studio, music recording, Church and play recording etc., £45, $90.

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Gramo. Motors New. Made in U.S.A. 4-speed, 240 volt A.C. 50 cyc. Only $2.75 each.
Post, N.S.W., 30c; Interstate, 40c.

240-110 VOLT 6KVA TRANSFORMERS

Encased, including switches, as new, $50. £25.

SPECIAL lucky dip valve offer. 15 new valves in cartons for only $2.00. We haven't got time to sort them, so you reap the benefit. Post, 30c.

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ANSWERS TO CORRESPONDENTS – continued

ELECTRIC GUITAR AMPLIFIERS: Do ou have available circuit data, etc., for a 0-watt "solid state" guitar amplifier with ie additional facility of a dynamic micro-hone input? **(J. McQ., Cringila, N.S.W.).**

lo, we have not described such an ampli-er as yet, although we certainly intend) have a look at the proposition as soon ; we are clear of the valve type circuits. lowever, we would be very surprised if the ansistor designs did not turn out to be a ood deal more expensive.

ETERAN CONSTRUCTOR. I have been een on radio construction since 1912, and erved in the Signals in the first War. I ave built many receivers since. I have ved in New Zealand since retiring 15 years go, and have every type of test equip-ient in my workshop. I have had a lot of iccess with VHF receivers and would like) contact R.B. of Auckland, who wrote in ie March issue of his experiences with re-eivers, and anyone else with similar in-rests. **(E. M. Carpenter, 27 Towai Street, t. Hellers, Auckland 5, New Zealand. hone Auckland 587284).**

/e are always glad to hear from such nthusiasts and leave it to R.B. and others) make the necessary contact.

UBLICATION SUGGESTIONS. Would it ; possible to print the common wire gauges ith their dimensions in inches and centi-etres? Also, will you publish a two-tran-stor tape recorder to record tapes at school r play-back at home later? I am also terested in the history of radio, etc., and onder if you could publish a general rticle on this. **(A.Y., Sunshine, Melbourne, ic.).**

hese are interesting suggestions, A.Y., hich we will consider. The wire data can) found in many reference works, but e may publish tables at some future date. he history can also be read in any books, but it could take too much ne and occupy too much space to be nsidered at present. The portable tape re-rder sounds fine, but it would be difficult not impossible to obtain the mechanical rts. In any case, it is possible to buy ieap recorders which would probably be ood enough for the purpose you have in ind.

UITAR AMPLIFIER. Would it be ossible to publish a guitar amplifier of out 20 to 25 watts with a vibrato or emolo using low cost parts for the younger aders? **(P.G., Kogarah, N.S.W.).**

e published a guitar amplifier in October, ovember, and December, 1962, and in nuary, 1963, which meets your perform-ice specifications, P.G., but it may be ther more costly than you are hoping for. is impossible to get something for noth-g, P.G., and if you want a good output th extras, you must be prepared to pay r it.

)GIC PROBLEM: I would like to suggest further problem which could be solved th the recently-described Digital Demon-ator — the old teaser about the farmer th a goose, a fox and a bag of corn, who ist cross a river in a boat capable of rrying only himself and one of these with-t leaving alone either the fox and the ose or the goose and the corn. Using gical symbols and a Karnaugh map one n find a minimal expression of the "dis-trous" combinations of the "variables," that one can set up the NOR gates of e demonstrator to detect these as repre-nted by the four flip-flops (one flip-flop presenting each variable as "this side" or at side"). Push buttons can then be ed to find a sequence of operations which uld take the flip-flop from "All this side" "all that side" without passing through e of the "disastrous" combinations. There e probably many puzzles like this one ich could be solved quite dramatically using the demonstrator in a similar fashion. **(P.G., Bondi Junction, N.S.W.)**

Many thanks for the letter, P.G., and we agree that one can certainly use the demonstrator in this fashion. However we imagine that in most cases one would really need somewhat more hardware than is provided by the basic demonstrator; even in the problem which you mention, this would be true if the demonstrator were to be used to actually **find** the answer rather than simply provide a convenient means of checking a sequence already worked out on paper. Unless the additional hardware were added, the Karnaugh map alone would probably be of almost as much value as the demonstrator. Still, we're happy the unit is providing food for thought!

METRONOME... PLUS! I have been a keen reader of your magazine since 1947, have built many projects and enjoyed the many theoretical articles. It has been pleasing to watch the magazine grow in size and sophistication, keeping up with changes in the industry. Referring in particular to electronic metronomes and the one with accented beat, would you consider the idea of (1) a metronome feeding a pulse of light to all music stands in a band, the tempo being under control of the conductor and (2) developing from the metronome an electronic percussion generator, such as is used sometimes with electronic organs? **(M.W., Blackburn, Vic.).**

Thank you for your very kind and encouraging remarks. We would have serious doubts about the idea of an electronic metronome to control a complete group. Electrically it should not present any insuperable problems but musically it might. If heeded, it would probably result in an unduly "mechanical" beat; if not heeded, it would lead to chaos. We've already had a look at the second idea, with a tentative hook-up between the accented metronome and our earlier white noise generator. Our impression was that an elementary hook-up was not worthwhile and that a lot of extra circuitry would have to be added to control envelope shape and frequency content. In short, it looked like involving a major effort, not just something that could be strung together from a few bits. We are still very interested in the whole idea, however.

RADIO CONTROL: What is the size of the printed wiring board for the "radio control" transmitter featured in the December, 1965 issue of the magazine? **(J.H., Daylesford, Vic.)**

The size of the board was 2-1/8 x 5-1/8 inches. It was available at the time from Silvertone Electronics of 727 Prince's Highway, Tempe, N.S.W.

CAR RADIO: I have a car radio which is unsuitable for my car because of the wrong polarity. Heaters and plates run directly from the car battery. Do you have a power supply design which could run this set from the power mains? **(K.C., New Lambton Heights, N.S.W.).**

Most car radios have provision for changing polarity to suit the car and, before you write this one off on this account, seek the advice of someone in your area who specialises in this type of receiver. On the other hand, it may be that the set is one of the very limited breed in which the plate circuits operated at 12 volts and that the polarity is not easy to change on this account. Still ask, however! No, we don't have any power supplies designed to operate car radios from the mains. We couldn't undertake to work one out especially for you. Whatever the type of receiver, the best way to tackle such a proposition is to separate out the heater and high tension circuits, with a view to operating the heaters from an AC heater winding of suitable voltage on a power transformer. This greatly simplifies the problem of providing filtered DC for the plates and screens, whether this needs to be a modest 12 volts or the more usual 200 odd volts. In thinking of measures along these lines you had best be sure that the whole effort will be worthwhile. Spend too much and you will find yourself wishing that you had put the money towards a new or second-hand set of more suitable design.

TRAIN CONTROL-PLUS! Why not produce an article combining the ideas used in the model train controllers of April 1960 (which permitted individual control of several trains on the one track) and of March, 1967 (which included simulated inertia)? This would just about make the model train enthusiast's dreams come true and would nicely round out the series of articles on controllers. **(K. L., Rosanna, Vic.)**

It may be possible to combine these two projects in the manner you suggest K.L., but our impression is that it would result in a very complex set-up and one which would require a lot of equipment to be packed into the rolling stock. There is also the problem that the April 1960 design does not lend itself to simple reverse facilities, a limitation which is unacceptable to many enthusiasts and which is quite difficult to overcome. Nevertheless, we will keep the idea in mind in the hope that we may find a solution to these problems.

ANSWERS TO CORRESPONDENTS—Cont.

SPECIAL DESIGN. I am very pleased wi the results which I have obtained with t single transistor reflex receiver published June, 1963. Would you design an aud amplifier for me using two transforme which I have on hand. I would be ve pleased to pay for this service. **(J. E. Dalyston, Vic.)**

We are pleased that you have been so su cessful with the simple receiver, but we ca not help you with your design proble since our staff is fully occupied in the ta of producing the magazine and coping wi the relevant services which are current offered. To set up a section to cope wi the "special" problems of individual reade would be an involved and costly operatio even assuming that it was practical, wi the present shortage of technical personn having the necessarily wide backgroun The charges would probably have to quite steep to make such a service bre even.

2-WAY RADIO. With reference to Har Tyrer's article on the new 30KHz separati for VHF mobile stations (June 1967) would say "Amen"—particularly to t paragraphs concerning loss of signal-t noise ratio in FM equipment. **(S. L., Bla land, N.S.W.)**

There have been a lot of arguments abo this subject but there seems little doubt th narrowing the bandwidth is making it a l harder to justify claims for superior perfo mance from FM. In fact, it is not just question of narrowing the gap betwe them. The advantage is likely to vary degree or disappear altogether, dependi on the kind of noise involved and the sign strength in the relevant receiving area.

DISCARDED PARTS. Could you give some addresses of people who may ha surplus radio parts in their junk box, whi they would be willing to give away. I wou like to take up the hobby of building radi but I feel that it would be too expensive f me if I have to buy all new parts. I c arrange to pick up any parts that a offered. **(J. W. B., Liverpool, N.S.W.)**

Unfortunately, we cannot allow these pag to develop into a free exchange mart f readers, much as we sympathise with the needs and problems. For one thing, simply cannot afford the space for such service, since it would be a case of "one —all in!" For another, there is a very re risk that such a service could be seized upo as a form of free advertising—offering som thing free as a means of establishing cor mercial contacts with readers.

FREMODYNE FOUR: I would like enlarged circuit diagram of the Fremodyn Four, instructions, price of a kit an where to buy it. **(G. L., Brisbane, Q.)**

A copy of the complete article is availab for 20c, but we cannot supply an "e larged" circuit. For details of kits, pric etc. you will have to consult our adve isers.

READER BUILT IT

(Continued from page 89)

Editorial note: If a speaker of low impedance than 150 ohms is used, wi transformer matching, it would be ver desirable to fit an emitter resistor TR4 to prevent thermal runaway. Th would be even more desirable with 9 than with 6V operation. A resistor 47 ohms should be satisfactory, bypasse with a high value, low voltage electr lytic capacitor. The bias resistor w need to be altered in value to resto the operating current, but this will b necessary in any case, if transform coupling is used in place of a hig impedance speaker.

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AND K TV Analyst model 1076ES exc. condition. $200. Also B and K transistor analyst $100. Write 94 Albion Road, Ashburton, Vic.

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Melbourne "AGE", Sound Supplement, 24th April, 1967.

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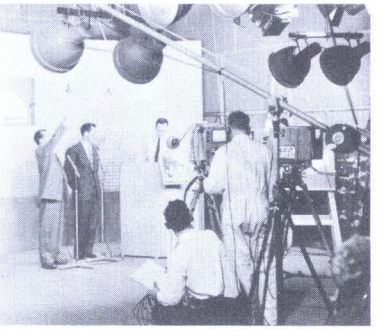

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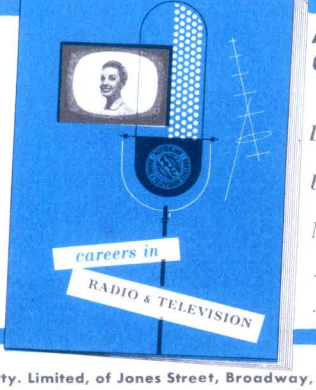

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